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to the Advancement of  
the Science of Orthodontia*

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# The International Journal of Orthodontia

*Editor: Martin Dewey, D.D.S., M.D.*

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VOL. I

ST. LOUIS, MARCH, 1915

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## ORIGINAL ARTICLES

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### THE TECHNIQUE OF ACCURATE MODEL CONSTRUCTION.

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BY SAMUEL J. LEWIS, D. D. S., KALAMAZOO, MICH.

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**I**N JUDGING a picture or the work of an artist," says Van Dyke, "we should first examine it by taking up the skeleton, the foundation of painting—drawing." He continues to say that one cannot do a picture well, especially in oil, unless he has first mastered the art of drawing. This fact is applicable to my subject, emphasizing as it does, the importance of this preliminary step in model construction, for accurate model-making with the orthodontist bears much the same relation to his finished work as the artist's drawing does to his.

Rearranging the teeth in the human jaw has been placed on a pedestal as one of the highest arts; hence, it demands that each step, from the taking of the impression to the removal of the retention, should be done with the highest degree of accuracy. Dr. Angle says: "It may be put down as quite a general rule that the degree of perfection of models he makes is indicative of the knowledge, skill and success of the orthodontist in the treatment of his patients," and Dr. Pullen has rightly said that the appearance of the models in an orthodontist's cabinet is an index to the character of the work that he is doing; that is, if his models are poorly or carelessly made, the other work is very likely to be slovenly. This is an undeniable fact.

This paper was prompted by two things: First, the observation of the necessity of more care on the part of orthodontists in general to their model construction, and secondly, the inspiration that the writer received while a student of Dr. Josef Grünberg, at the Angle School of Orthodontia. His teaching was, "What was worth doing at all was worth doing well."

Many busy orthodontists will apologize for the slovenly appearance of their models, and will tell you that they are so busy at the chair that they have not the time to finish them. To the man who is sincere in his work this is no excuse, for this step in his work is as important to him as the history and diagnosis of the case of a patient is to the physician and surgeon. Woe be unto him should he neglect this part of his work as the orthodontist does his.



Since the publication of the seventh edition of Dr. Angle's book, "Irregularities of the Teeth," which contains the best argument, and one of the best schemes for the construction of accurate models, there is no feasible excuse why any one should in any way neglect this all important step in the treatment of his cases.

In the following, the writer has endeavored to take up each successive step in the construction of models, from the assembling of the impression to the finishing of the models. And, while he lays no claim to any originality, if he has conveyed to the reader a method whereby he can improve his technique, then his labors will be well rewarded.

*Placing the Impression Together.*

After the impression is removed from the patient's mouth, it is placed in a tray upon which lies a piece of blotting paper. This is used to absorb the moisture from the pieces of plaster, and to facilitate the drying process. A scheme devised by Dr. W. S. Watson, of Brooklyn, N. Y., will be found of great service in laying out the parts so that they may be assembled easily.

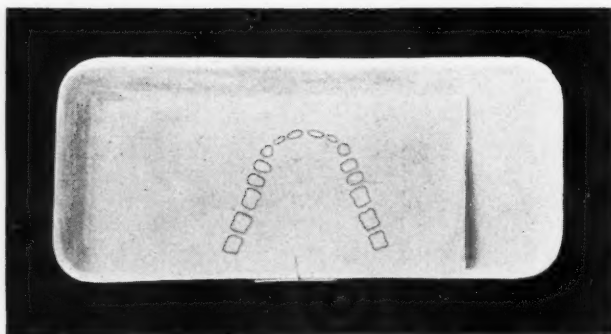


Fig. 1.—Tray and diagram on which pieces are laid.

It is as follows: The diagram represents the cross-section of each tooth so that each part of the impression as it is removed from the mouth can be laid in its proper place (Fig. 1). The pieces are allowed to remain for a few hours in a warm room until they are sufficiently dry to have the sticky wax adhere to them. The plaster, however, should not be allowed to become too dry, as the shrinkage may interfere with the fitting together of the parts accurately, and so make an inaccurate whole. On the other hand, an attempt to assemble the parts while they are too wet would also result in failure. One thing should be borne in mind; that is, not to allow the broken impression to remain in the tray for a day or two, but your time should be so arranged that it can be assembled the same day that it is taken. This is why so many models do not occlude properly after they are finished.

When the parts are in their proper condition, the smaller pieces are united to the larger ones with a good grade of sticky wax,—one that is very hard when cold,—and the larger pieces then assembled. The smaller pieces can be united with liquid celluloid. Care should be taken that the parts be not adjusted and readjusted too many times, for in doing this the fine serrations are destroyed, and the parts will not go together accurately.



Decide just what parts belong together, and then unite them at once with wax. During the process of assembling your assistant can be of much service to you in dropping the melted wax while you are holding the parts together.

*Retouching.*

Very few impressions when assembled are perfect in detail, especially that part where the anatomical and art portions unite. Especially is this so of the distal part of the buccal portion, which, as a rule, lacks good outline. This may be due to a faulty fitting of the tray to the mouth, or it may be due to the action of the buccal muscles during the setting process. In any event the impression should be allowed to stand in a shallow glass dish, filled with water, until it is thoroughly wet,—not too wet however. A small amount of plaster is sifted into another dish and with a No. 3 camel's hair brush, the soft plaster is added to fill out the parts that are lacking. Care should be taken that the plaster does not get onto the anatomical portion,



Fig. 2.—Lower impression before retouching.

or the teeth, but should be confined to the art portion alone. The lingual portion of the lower impression should also be built up in a like manner, and when the plaster has hardened, a piece of pink wax is placed over the part occupied by the tongue, so as to make a roof. This will eliminate creeping around this embrasure of an excess of plaster, and will greatly facilitate the pouring and separating (Figs. 2 and 3). When this is done, the impression is allowed to dry thoroughly, when it is ready for painting.

*Painting.*

The impression is now placed for an instant in water, because, should you apply shellac at this stage, it would be absorbed rapidly by the plaster, and would no longer serve as a guide when cutting or grooving the impression after it is poured. The water is absorbed by the plaster so that when the shellac is applied, it acts as a filler, and makes only a very fine layer. A good shellac, such as is supplied by the S. S. White Co., should be used. This

is applied first to the impression made by the teeth with a No. 1 camel's hair brush. Care should be taken, however, not to use a thick mixture, or that the brush be so filled that it drips. If this step is carelessly made, the fine fissures and cusps will be destroyed. A very small amount of shellac should be used on the brush, and then the surface should be carefully and lightly painted. Next the interdental spaces are painted, finishing the remainder, using a No. 3 brush, care being taken, however, that none ooze down onto the tooth portion. The impression is allowed to stand for an hour when it is picked up and examined to find whether any places are left untouched, or should need additional shellac. Should this be the case, and it usually is, around the teeth, these parts are lightly retouched, leaving the other parts undisturbed, after which it is again allowed to dry for about half an hour. The impression is again taken up, and in like manner, a thin layer of sandarac varnish is applied, which acts as the separator. If the sandarac shows a tendency to bubble while applying it to the teeth, this can

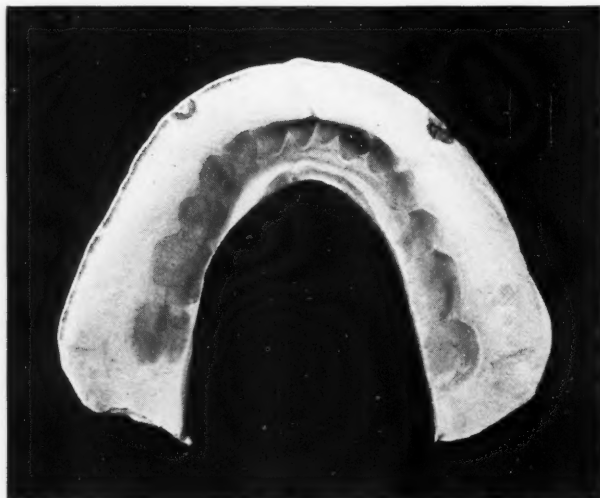


Fig. 3.—Lower impression after retouching. Lingual built across, which was to prevent plaster from running in between halves of impression.

be overcome by using a very small amount on the brush, and applying it very lightly, and sparingly. A great deal of patience is required here as the reproduction of the fine rugæ, stipples, and cusps depends entirely upon this part of the work. The impression is then allowed to dry for half an hour, when it is ready to be poured.

For convenience the writer uses three glass-topped preparation bottles; one for shellac, one for sandarac, and one for alcohol to clean the brushes in. Mention might here be made of the importance of choosing good brushes. These can be purchased at any art store and must be of good quality. Wooden handled brushes are the best. Should the brushes show signs of disintegration, or get out of shape, they should be discarded immediately.

#### *Preparation For Pouring.*

After the impression has dried thoroughly it is dusted with talcum powder, and then blown out with compressed air. This gives the surface a

smooth finish, so that the model has a polished surface; and this will prevent any shellac from adhering to the model. It is then placed in a shallow dish (Fig. 4), which is filled with water, so that the plaster may again become soaked. Care should be taken that the water does not touch the painted portion. The reason for soaking the impression at this point is that in shaping the soft plaster of the model there will be no water absorbed by the dry plaster of the impression.

#### *Pouring.*

Plaster of two kinds may be used: French impression plaster, or the ordinary model plaster. The writer prefers the impression plaster, as he is more thoroughly acquainted with its working qualities, and it makes a much whiter model. The plaster should be sifted, not mixed or stirred, for this causes bubbles and greater shrinkage. Also, no hastening medium should be used, as this changes the chemical action, and results in more shrinkage. A glass finger bowl is used for the mix, and a small amount of plaster on a broad bladed spatula is sifted carefully into the water, the blade being tip-

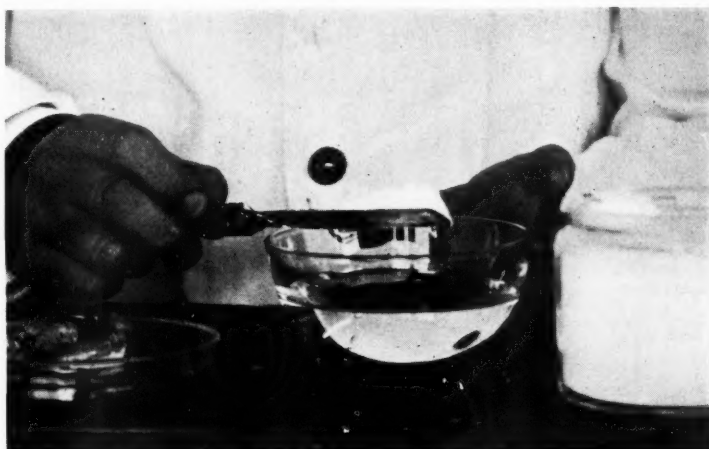


Fig. 4.—Tray on left shows impression in dish.

ped so that the plaster falls off on one side only (Fig. 4). This is carefully sifted until the mixture is about the consistency of a good whipping cream. If this is carried out to the point, no stirring will be necessary, and the plaster will be a homogeneous mass, without a bubble. It will also permit ample time for pouring without hurrying you. There is a fallacious belief that if a hastening medium is used the plaster will be much harder. Mix up two batches and allow them to thoroughly harden. Then take a sharp knife and cut into them. Invariably, you will find the sifted mix the harder of the two.

When the impression is thoroughly soaked, and the plaster mix is ready, the impression is taken in the left hand, and a small quantity of plaster is introduced with a No. 3 brush, at the right heel (Fig. 5). This is pushed forward carefully so that each tooth is filled without the formation of bubbles. When this is done, the impression is turned over and shaken so that it will be evenly distributed. A small amount of plaster is again placed in the heel and carefully brushed forward, always in the same direction; this to be repeated until the impression is filled to the edge. In this way there will



be no bubbles, and it is possible to fill every part of the impression. At this stage a quantity of plaster, which is now more dense, is placed upon a glass slab and carefully patted down to about the thickness that you wish the base

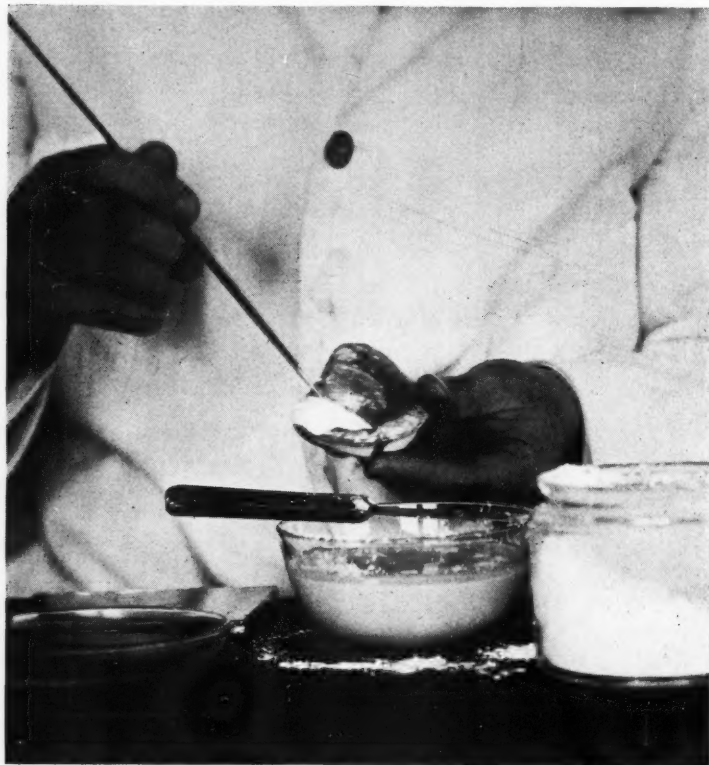


Fig. 5.—Filling the impression.



Fig. 6.—Turning over the impression after it is filled.

or capital to be. The filled impression is now turned over and placed upon this mix (Fig. 6). It is then adjusted in the case of the lower, so that the top of the impression is parallel to the base, and in the upper so that the

anterior portion is somewhat lower than the posterior portion. The reason for this is that usually the labial embrasure is higher than the buccal, and if it were to be placed so that the top is parallel to the base, the models when placed together would be uneven, and in many instances it would be necessary to add plaster to the posterior portion so as to make the capital and base of the finished model parallel. When the impression is turned over and adjusted from a horizontal direction, the back is evened off by placing the spatula flat against the impression on the glass slab and drawing it upward. This will take off the excess and leave a smooth surface. Next the sides are smoothed in the same manner, always drawing the spatula towards the impression; and if any additional plaster is needed, there will be enough

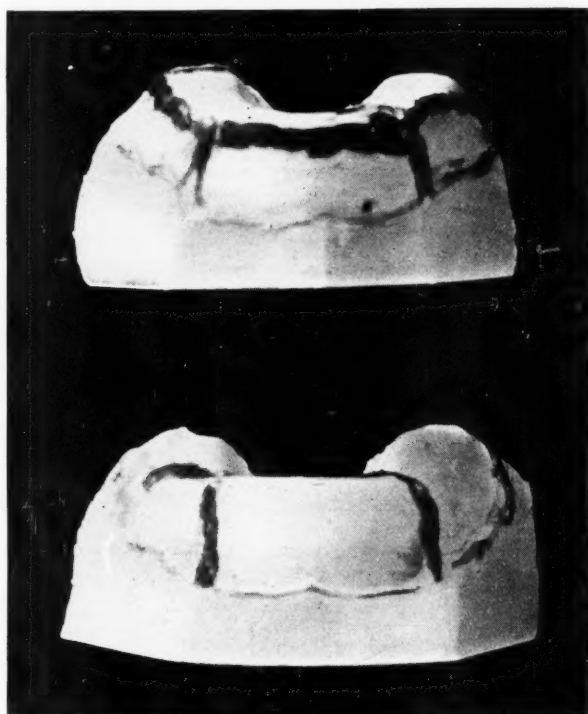


Fig. 7.—Impression poured and model shaped on glass slab.

on the spatula for this. The sides are made as nearly perpendicular as possible, never slanting, for this causes an unnecessary excess. The next step is shaping the anterior portion, which is done in the same manner, only that in the lower it is rounded as it is in the finished model, and in the upper it is made to come to a point at the median line. If this is done carefully there will be no appreciable excess and no plaster will adhere to the sides of the impression. The thing that should be borne in mind is that when the impression is poured, the shape should be as near the shape of the finished model as possible, and should have a clean appearance (Fig. 7). If this is done, there will be no need of using a photo trimmer such as Dr. Pullen advises, as this is only used to trim off the large excess. Do away with excesses of all sorts. This is Dr. Angle's teaching.

*Grooving And Separating.*

When the impressions have both been filled and shaped, they are allowed to stand, say over night, and on the next day they are ready for separating. The wax is then chipped off carefully so that not a vestige of it remains. Before grooving, a few pieces of bibulous paper, soaked in water, are laid over the impression so that it will absorb the water. In this way the impression becomes more workable, without altering the model, and makes separating much easier. A small plaster knife, which is kept sharp, is used to cut away the plaster over the occlusal surfaces of the teeth until the shellac begins to show. Care should be exercised here so that the cusps are not cut off. When the cusps of the buccal teeth and the incisal edges of the anterior teeth are seen, or rather, the shellac covering them, a groove is made all

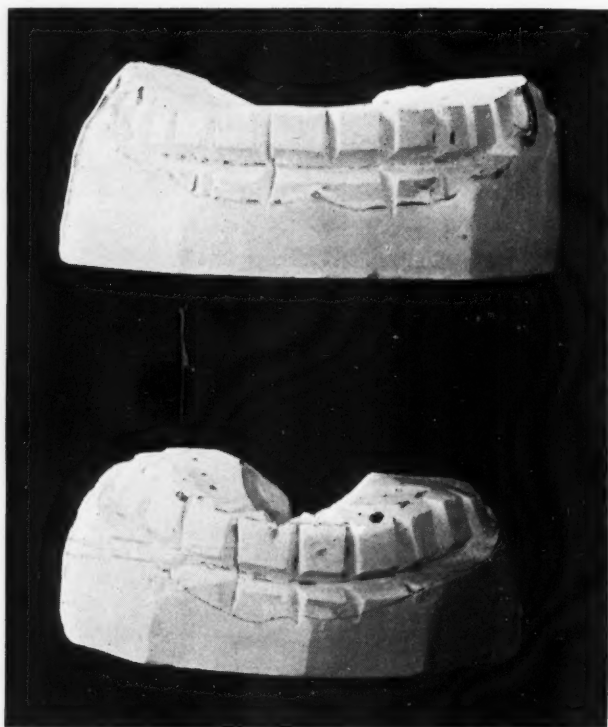


Fig. 8.—Impression grooved for separating.

around the buccal and labial portion of the impressions about opposite the free margin of the gums. This is made quite wide, and deep enough so that a fine line of shellac can be seen all around. Next perpendicular grooves are cut at a distance of about one-quarter of an inch all around the impression so that a fine line of shellac can also be seen (Fig. 8). The impression is then ready for chipping.

Starting at the right side, each square is carefully chipped off with a suitable instrument. This exposes the labial and buccal surfaces of all the teeth (Fig. 9). Next the thin covering of the occlusal surfaces is chipped off, care being taken that none of the teeth are jabbed. This can best be done with a small, sharp instrument, such as a small chisel excavator. The next step is, in the case of the upper, to remove the palatal portion. This can



best be done by making a groove through the median line, then extending one laterally from a line drawn from each cuspid tooth diagonally to a point posterior to the Papilla Palatina. These lateral halves are carefully removed, leaving a small amount of impression remaining around the palatal surfaces of the six anterior teeth. This is carefully grooved opposite each lateral tooth so that it can be removed in very small pieces (Fig. 10). This is necessary, especially when the teeth are crowded, as they often are. In the lower, the wax cover is removed, after which the lingual portion is grooved vertically, opposite the cuspid and molar teeth. These pieces are then chipped off, and as a rule they come off very easily. The remaining portion is then grooved opposite each tooth (Fig. 10) and each segment carefully chipped off. In case the incisors are overlapped, much care is necessary in

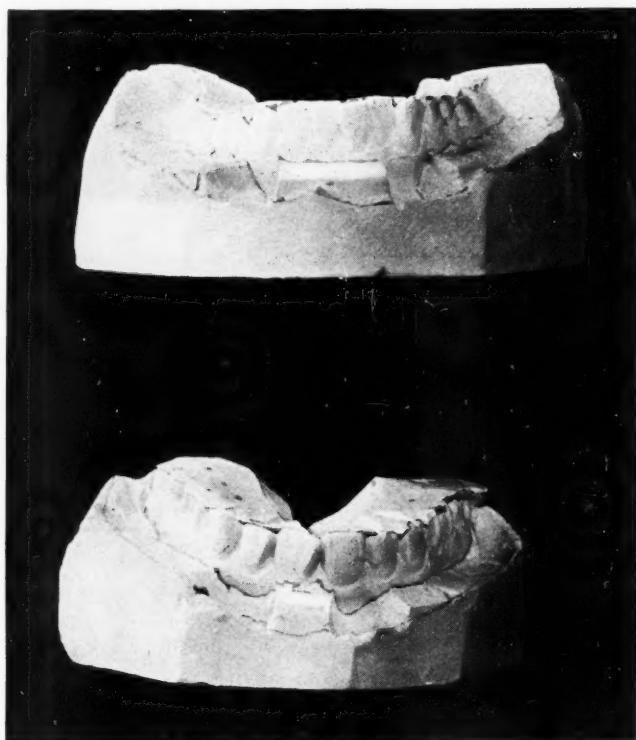


Fig. 9.—Impression partially removed from models.

order that the teeth be not broken. Now, all that remains is the portion of plaster on the buccal portion from the parallel grooves to the part representing the buccal and labial embrasures. This is carefully chipped off, care being exercised when the frænum labium is reached. No special direction can be presented here; only each chip must be taken off with the utmost precaution, and always away from the frænum. When this is done, the model is looked over carefully to see that no parts are missing, and that no small pieces of plaster are adherent to the interdental spaces, or the fissures on the occlusal surfaces of the teeth. The models, being free from any pieces of impression, are placed in a tray preparatory to carving (Fig. 11). The best time for carving is immediately after the impression is chipped off, however, there is no harm in allowing the model to remain for an indefinite

period. If this is done, the models should first be soaked for a moment in water, otherwise the plaster will chip when planing.

*Carving.*

The instruments used for carving the art portion of the models are a large plane, and Angle small plane (Fig. 12), a square, a pair of calipers and a universal bevel (Fig. 13). In order that no step may be missed, they will be taken in order of procedure.

The lower model is always finished first, as it serves as a guide to measure and finish the upper one. The first step is the balancing of the base,

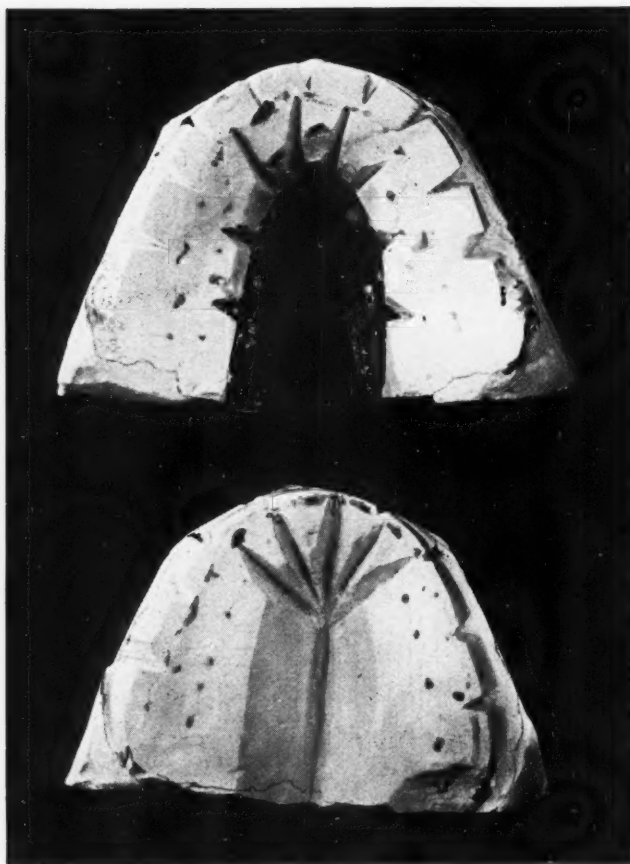


Fig. 10.—Showing grooves cut for the removal of palatal and lingual portions.

as the lower part of the model is called. The base at its thinnest point, that is, about opposite the lateral tooth, should be equal to about one-third of the anatomical portion at its widest point. This is determined by taking the adjustable square, placing the heavy part at right angles to the central incisor, and adjusting the small end of the ruled portion so that it rests in the labial embrasure. Add one-third of that measurement and at a point on the art portion make a mark with a sharp pencil. Next place the already adjusted square in exactly the same position on the molar teeth and make a mark. Then with a flexible ruler draw a line around the entire circumference of the model. This will serve as a guide when planing. The large

plane is then adjusted so that it takes quite a good-sized shaving, and the model is planed down almost to the line. The plane is then readjusted so that it takes a very fine shaving, and the model planed until the line is reached. A very fine adjustment must be used, otherwise there will be lines left where the side of the blade has cut into the plaster. When the line has been reached, the ruled part of the square is placed laterally, and antero-posteriorly upon the surface to see that it is perfectly flat. This is very important as the remaining surfaces are determined by the base.

When this surface is accurately made, the model is turned over and one point of the calipers is placed lingually between the central incisors, the other part reaching a point posterior to the last molar tooth, and marked. It is then carried to the opposite side and marked. This is to produce a

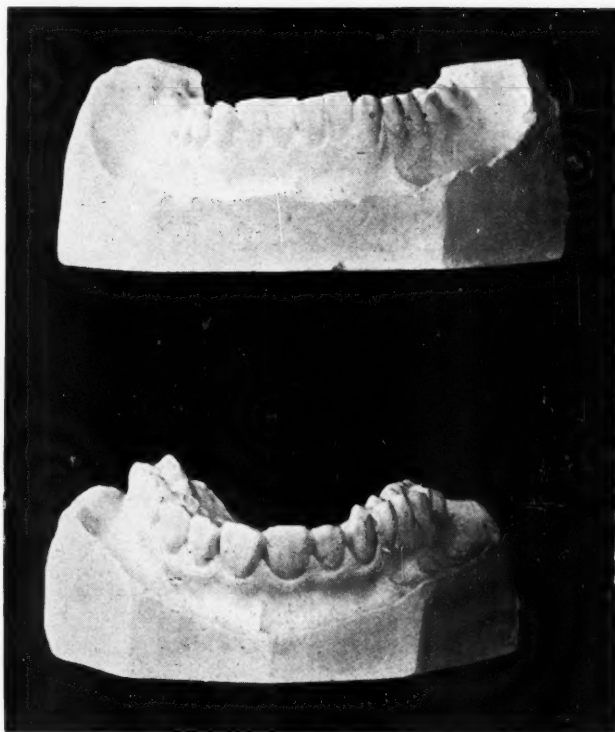


Fig. 11.—Models free from the impression.

symmetrical model. The small Angle plane is then used to plane off the posterior portion of the model, planing until the points made by the calipers are reached. At frequent intervals, the square is used to determine the angle, for all surfaces are made at right angles to the base. A great deal of care is here needed as it is very easy to get the back at the wrong angle, and so destroy the accuracy of it. When this surface is planed, and a very fine adjustment is needed at all times on these surfaces, one of the lateral sides is planed parallel to the buccal cusps of the buccal teeth, and at right angles to the base. The eye must here be used accurately, as a large part of the beauty of the models depends upon these lines being parallel. When this surface is finished the universal bevel is adjusted by placing the large portion against the back, adjusting the other part against the complete side, and then



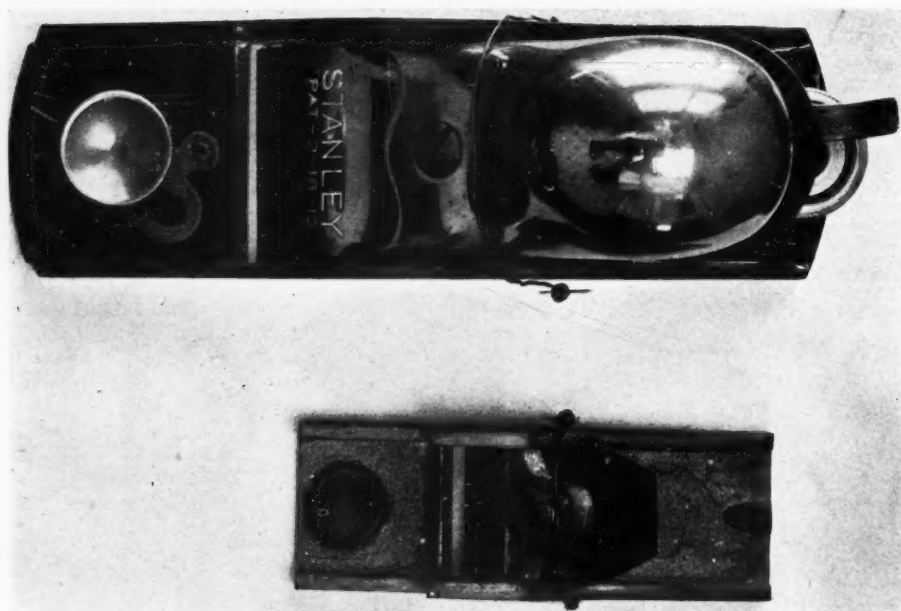


Fig. 12.—Large plane and small Angle plane.

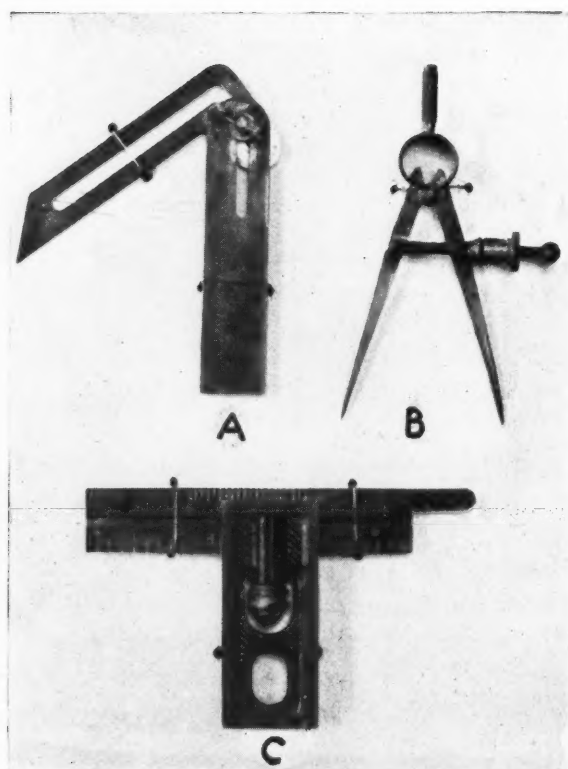


Fig. 13.—A, Universal bevel; B, Calipers; C, Square.

tightening the set screw (Fig. 14). This is reversed and the opposite side marked, and planed, also at right angles to the base (Fig. 15). A point is then made opposite the buccal half of the cuspid tooth, or at a point where it should be, on both lateral parts. The square is used to draw a perpendicular line through this point. Where the line reaches the base, two points are made. The distance between these two points is measured with the

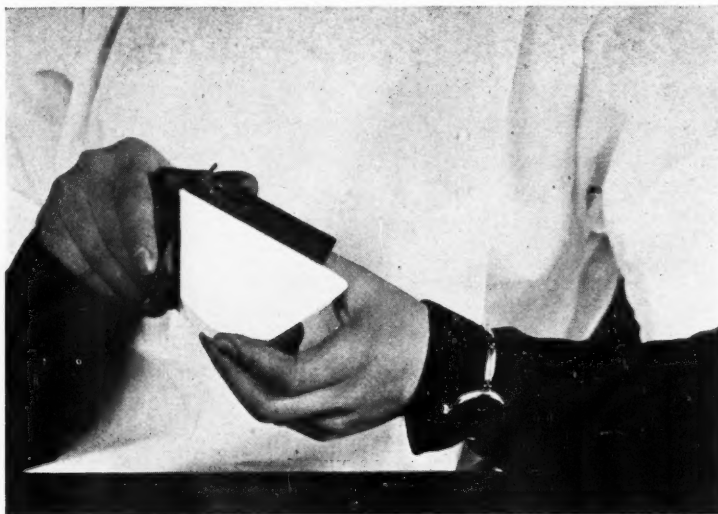


Fig. 14.—Showing use of universal bevel.



Fig. 15.—Use of universal bevel to get both sides at the same angle.

calipers, and using each point as a center of a circle, two marks are made where they intersect. The caliper is then placed at this point and an arc made that passes through each point. This marks out the anterior part of the art portion, which is then planed off, also at right angles to the base.

All that needs to be done now is to square off the posterior corners. This is done by drawing a line from the point opposite the cuspid teeth to the

posterior corner. A line is then drawn at right angles so that each corner is made square and should be one-quarter of an inch in length (Fig. 16).

By using the square again, two lines can be drawn from the ends of this line perpendicularly so that it may be planed off at right angles to the base. In planing this surface, always start from the base and plane towards the anatomical portion, otherwise the fine sharp edge will be destroyed. When this is done, round off the surface as shown in Fig. 17 (a). Now all that remains is the squaring off of the back, which is done by using the square for marking and a sharp knife for cutting, Fig. 17 (b). The carving is now completed for the lower, and the upper is ready for carving.

The size of the top, or capital as it is called, is determined in exactly the same way as the lower one, but the difference lies in the balance of the mark-

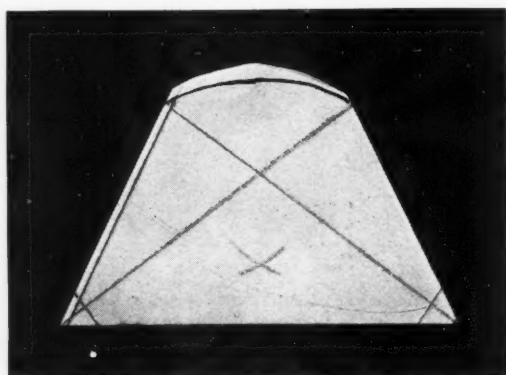


Fig. 16.—Marks on base of model to show how front and posterior corners are trimmed.

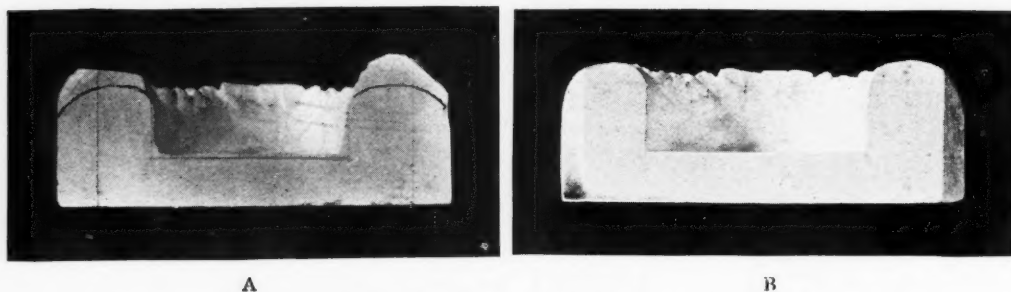


Fig. 17.—A, Back of lower model marked for trimming; B, Back trimmed and rounded off.

ing. The capital should always be parallel to the base, and this is done as follows: The models are occluded accurately and held in the left hand. The square is adjusted as in the lower, the end reaching a point where the capital should be, and marked in a few places (Fig. 18). A line running through each point will be parallel to the base (Fig. 19). This is planed in exactly the same manner as the lower one. When this is completed the model is trimmed off in the back so as to be on a plane with the back of the lower one. The sides are then trimmed in exactly the same manner as the lower, using the universal bevel for marking. In finishing the anterior portion the only difference is that a line representing the median line of the model is made to a point opposite the anterior tip of the *frænum labium*. Now instead of marking an arc, lines are drawn from the points opposite the cuspid teeth to



this point, and these surfaces carefully planed off (Fig. 20). The blade is started at the right side near the cuspid tooth, and planed towards the frænum. The opposite side is then planed in exactly the same manner. This insures good sharp lines and corners. The posterior corners are then trimmed in exactly the same manner as the lower. If these steps are carefully carried out, the models at this point will look like Figs. 21 and 22, which are the models made from the impressions used in the illustrations. We are indebted for this scheme of marking out the art portion of the models to Dr. Martin H. Dewey, of Kansas City, Mo.



Fig. 18.—Method of marking upper model so as to make base and capital parallel.

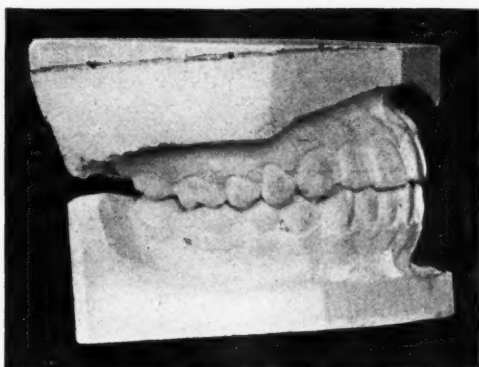


Fig. 19.—Line drawn showing method of marking the top.

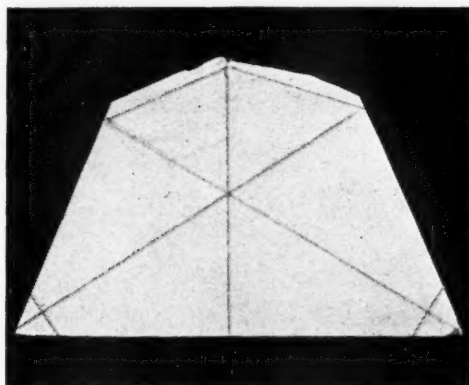


Fig. 20.—Lines on upper model showing wheer model must be trimmed.

### *Retouching.*

During the process of carving and planing, jabs may be made into the plaster, a tooth may be broken off, or a bubble or two may appear, none of which can be prevented at all times. In this case, plaster will have to be added artistically, as follows: The models are soaked in water until they have absorbed as much as possible, and then dried off with bibulous paper to get rid of the surface water. Some plaster is sifted into a shallow dish, filled

with water, and with a No. 1 camel's hair brush, these defects are carefully filled in. It is even possible to restore a broken corner of a tooth with such a degree of accuracy that it will escape detection, even by the eye of an expert. If a tooth has been broken off, an undercut is made in the broken part, and the remaining part, and these are carefully filled with fresh plaster and adjusted. With care this also can be done so that it will escape detection. The Detroit Dental Mfg. Co. gets out a plaster cement for this purpose, but the writer has never tried it, so can say nothing for or against it; however, the use of ordinary cements should be discarded. With them it is impossible to produce an artistic result.

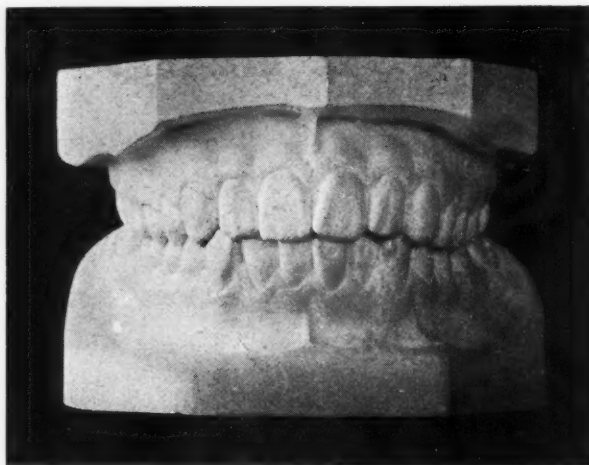


Fig. 21.—Showing front view of models.

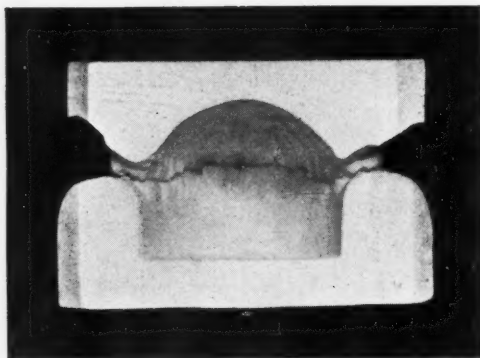


Fig. 22.—Showing back view of models.

When the retouching is finished, the models are laid away to dry, never resting upon the anatomical portion, but always on the base or capital. While they are slightly damp, or if they are thoroughly dried they can be immersed for a moment in water, a No. 6, double end Ash instrument is used to carve out the plaster from between the teeth, or to smooth off the retouched parts, when the models are ready for the final treatment. This consists of dusting all surfaces with fine talc, and running a very fine flat file over the art portion so as to give it a smooth finish. The same is done to the anatomical portion, only a pellet of cotton is used to rub the talc in.

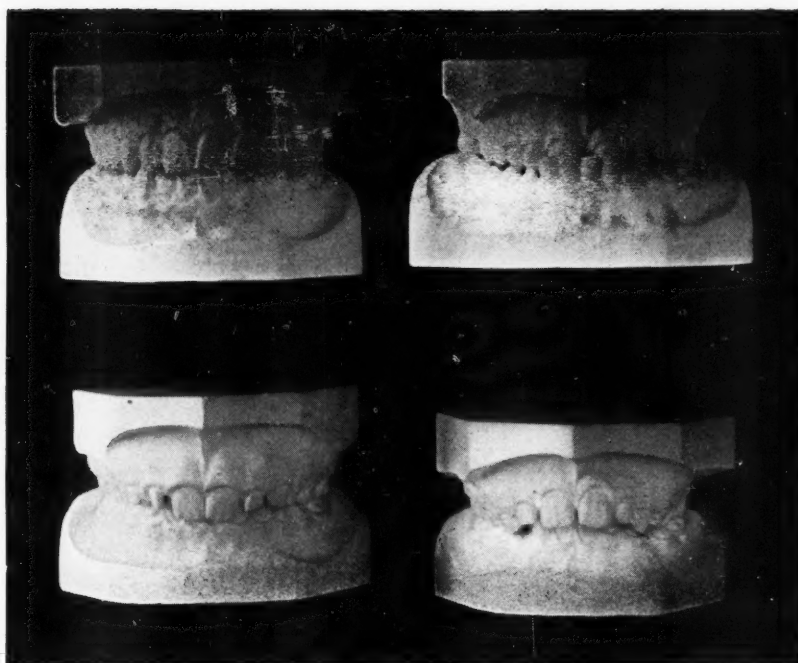


Fig. 23.—Showing four finished models.

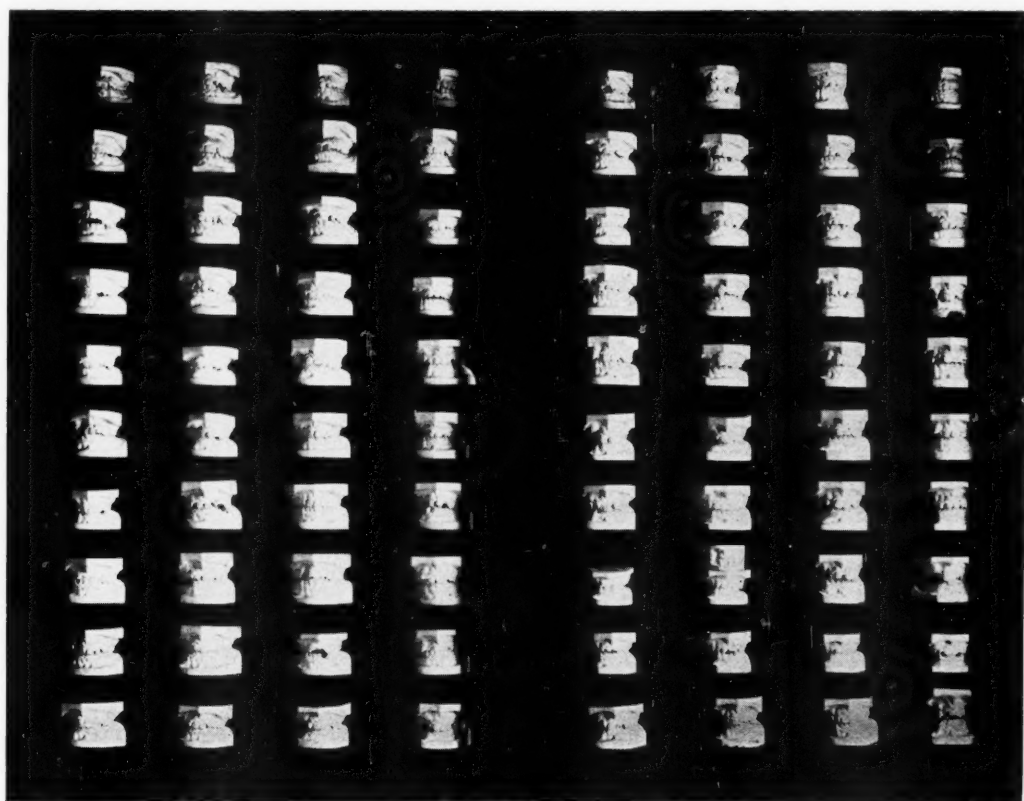


Fig. 24.—Writer's model cabinet.

This is blown off with compressed air, which treatment leaves the surface smooth and shiny without destroying any of the fine rugæ or stipples. This also serves as a means to keep the models clean, so that they can be handled without one's being afraid of leaving finger marks on them. This does not, however, insure them from soil or dirt, especially in cities where a great deal of soft coal is burned.

If each step in the construction of the models be carried out carefully, and accurately, the finished models will look like those represented in Fig. 23.

#### *Conclusion.*

If this method, as outlined, be carried out in detail, with a little practice one can produce models the beauty and accuracy of which will reflect credit upon his skill, and when a visitor enters the office, no apologies will be necessary, as they are when the models are slovenly made. And, in the words of Dr. Angle, "A collection of fine, accurate models is not only an incentive to keener interest and better work, but is a most valuable form of 'library' in itself, in which many valuable phases of the subject are recorded than can ever be reduced to writing."

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### A SHORT NOTE ON CLASSIFICATION.\*

BY J. SIM. WALLACE, D. SC., M. D., C. M., L. D. S., LONDON.

DR. ANGLE says that "in diagnosing cases of malocclusion we must consider the mesio-distal relation of the jaws and dental arches as indicated by the relation of the lower first molars (with the upper first molar) the key to occlusion." He recognizes the fact that the loss of a tooth or teeth by extraction is shortly followed by changes in the position of the remaining teeth, which, when reckoning the occlusion, have to be allowed for. This latter admission I will not refer to further, as it only complicates matters and my intention is simply to show that Angle's classification is always misleading, even under the most favorable circumstances.

To avoid confusion I am going to treat the question from what may be called Angle's point of view, that is, the relation of the jaws and dental arches as indicated by the relation of the lower first molar with the upper first molar. It is my intention to show that the normal positions of the dental arches can never, or at least cannot in nine cases out of ten, when the teeth are irregular, be judged from the position of the first molars, for the simple reason that in nine cases out of ten the first upper molar is translated forward and slightly inward along an arch which frequently coincides with the normal arch in the region of the incisors, but seldom or practically never in the molar region.

For Angle's purpose it is convenient for him to claim that the first molar is the key to occlusion and to try and locate it, but it is only in words that he manages to do this. Now let me quote again from Angle; he says: "Being

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\*Read before the European Orthodontia Society, Sixth Annual Meeting, London, 1913.



the first of the permanent teeth to take their positions in the arches, they exercise great control over the positions which the other teeth anterior and posterior to them shall occupy as they erupt at their respective periods and take their respective positions in the arches. As they are already developed and firmly attached in the alveolar process when the other teeth appear, the latter are built into the dental apparatus around them, as it were. They are not only the most constant in the time of taking their positions, but by far the most constant in taking their normal positions."

I think you will all agree with me that we must refer to what is normal and how the teeth normally take up their correct position in the dental arch. To illustrate this point the two slides may help us. Fig. 1 is (approximately) the normal dentition of a seven year old child. Fig. 2 is the normal adult dentition.

Now, as you know, the sum of the mesio-distal diameters of the temporary molars and the canine is about equal to the mesio-distal diameters of the

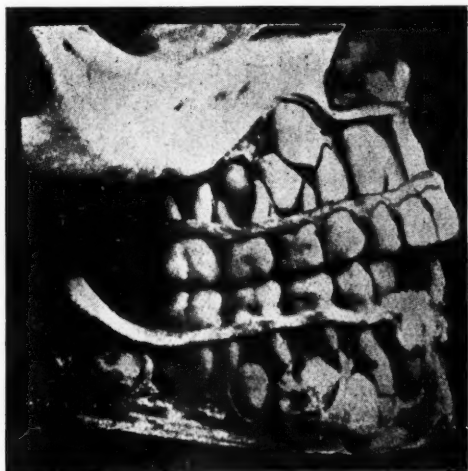


Fig. 1.

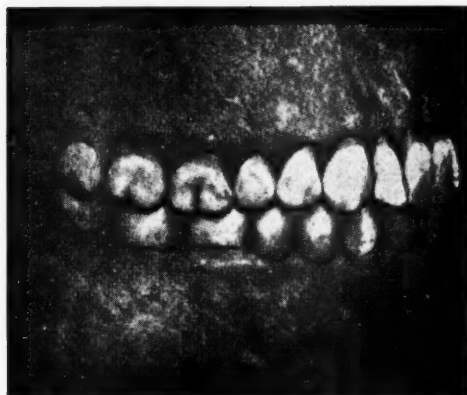


Fig. 2.

two premolars and the permanent canine. Similarly, the sum of the mesio-distal diameters of the temporary incisors and the spaces, which in a well-developed jaw exist between each of these teeth and between the temporary canines, is practically equal to the sum of the mesio-distal diameters of the permanent incisors. (We need not make complications by referring to the slight anterior inclination of the upper permanent incisors; this is counter-balanced perhaps completely by the fact that there are frequently spaces between normally arranged incisors.)

This being so, it is obvious that normally the first upper molar takes up a position at a distance from the alveolar point, which is the sum of the mesio-distal diameters of the incisors, the canines and the premolars on either side when measured round the regularly arranged or normal arch. Further, we must note that the front part of the maxillæ and mandible is not the part of the jaw which grows. Once the front part is formed, it is formed, and the distance measured from the first molar to the alveolar point is practically constant. On the other hand, posteriorly, that is, behind the second tempor-

ary molar tooth, growth takes place by deposition of bony tissue on the posterior part of the maxillæ (or mandible.)

This deposition of bone allows the coming into proper position of the permanent molar teeth, when the bone deposited posteriorly has been formed in sufficient quantity. Fig. 2 shows the amount of bone which is developed subsequent to that which is formed to carry, without crowding, the twenty front teeth, i. e., all the bone above and behind the second temporary molar or second bicuspid. But one of the chief characteristics associated with irregularities is the fact that the maxillæ and mandible are subnormal in their development. Leaving out of account lack of development in breadth which necessitates a position of the molars lingualwards of normal, lack of development posteriorly necessitates a forward translation of the first molar, and the teeth in front of it must either take up a crowded and irregular position, or if not that, at least the canines and incisors are tilted forward. If, then, we have a case of crowding due to lack of space in front of the first molar, we have positive proof that the first molar has erupted abnormally far forward or has traveled forward subsequent to eruption; in other words, Angle's Class I may be defined as cases in which the mesio-distal relation of the first molar is mesial to its normal position in a normal arch.

Angle admits that the first molar may come rapidly forward on account of premature extraction of the second temporary molar. That a force capable of carrying the first molar is potentially present, is admitted. That this force is not potentially present when the temporary teeth fall out normally, is Angle's assumption. All that can with truth be said however is, that two or more teeth are moved more gradually than one. When one or more teeth are crowded out of the arch, we see clearly, unless we are prepared to deny the facts concerning the developmental anatomy of the maxillæ, that the first molar has traveled forward. As regards tipping of the molars, this very seldom happens when the forward translation has been very gradual, because the occlusion, if nearly right to commence with, remains so by the mutual relations of the opposing teeth.

The last fallacy in Angle's classification, or rather the last one that I intend to refer to today, is his belief in "wedging" as a cause of development of the jaw. Normally there is no wedging, and the teeth come into position practically without trouble. Furthermore, when the jaws are normally developed the loss by some accident does not cause rapid displacement of neighboring teeth; indeed, under certain circumstances, perhaps under all circumstances, less abnormal displacement of succeeding teeth results from extracting temporary teeth and restoring health and the normal developmental stimuli for the growth of the jaws than can be gained by keeping functionless temporary teeth at the expense of the general health of the child.

#### DISCUSSION.

*Dr. Chiavaro* said he had been impressed with the ideas that *Dr. Sim. Wallace* had put forward with regard to the growing of bone. In studying the embryology of the teeth he had explained to his students that there was a trinity; the alveolar process, the pericementum or dental ligament, and the cement of the teeth, formed a trinity as they all came from one connective tissue, which in the germ of the tooth was the follicle. The papilla was building the dentin and the organ of the enamel was building after the first layer of

dentin, and those two important organs arose by the thickening of the connective tissue called the follicle. The sac was outside the alveolar tissue and above the mandible. No one spoke of alveolar tissue as bone. The connecting membrane while it was forming was building outside the alveolar process and inside there was the cement and the dentin, and between was the ligamentum of the peridental membrane. That was the trinity and it was very important in orthodontia to remember, because those three tissues were always together. When the cement of the temporary teeth and the peridental membrane were lost they were lost for want of nutrition. The alveolar process of the permanent teeth had nothing to do with the alveolar process of the temporary teeth. When a tooth was moved the root was moved, and with the root the cement, with the cement the peridental membrane, and with the peridental membrane the alveolar process. The building of the bone was done by the osteoblasts which were a part of the ligamentum, the peridental membrane. If the peridental membrane was destroyed, the alveolar process could not be built. That was why in pyorrhea alveolaris, when the margin of the alveolar process was destroyed it could never be built up again, because with it were destroyed the cells which made the alveolar process. That was the reason why pyorrhea alveolaris was so difficult to cure. The connective fibers of the ligamentum were between the alveolar process and the cementum, and they remained embedded in the alveolar process on one side and on the other side in the cementum, and were ossified; so that it was impossible to speak about the building of new bone tissue on the posterior teeth as Dr. Sim Wallace had done. The alveolar process tissue of the temporary teeth was entirely absorbed after the loss of the temporary teeth.

*Mr. Markham* said he entirely agreed with what Dr. Sim. Wallace had said. If Angle's classification was based upon the relative positions of the first permanent molars, then there was practically no use for orthodontists, because it was necessary to classify the abnormality before the first permanent molars had erupted. He had seen several young children in whom he had classified the abnormality before the first permanent molars had erupted, and it was necessary to do that before a case could be successfully treated, and Angle's classification would fail for that reason. It had also struck him that the first permanent molars erupted as close as possible behind the second temporary molars. He had rather questioned Angle's classification and had looked to see the conditions at the end of the temporary dentition, the occlusion of the temporary molars. In some cases of Class I, judged by the interlocking of the canines in the temporary teeth, he had been surprised to find that the lower temporary molar overlapped backwards the upper temporary molar. When the molars erupted that case would be a case of Class II, although in the temporary dentition, judged by the profile of the patient, it was Class I. In another case the patient was of a later age and he treated it as a case of Class II, and after some months he found it was a case of Class I. There was some abnormality in the sizes and shapes of the upper temporary molars and the first upper permanent molar had erupted too far forward. It had followed as close as it could to the second upper temporary molar. In cases where the first upper permanent molar erupted rather to the lingual side of the temporary teeth, there was a forward translation of the first upper permanent molar.

*Dr. Solbrig* said that Dr. Angle's classification was a very convenient one and a classification which he should continue to use. He was sorry such an eminent man as Dr. Sim. Wallace had not put forward another classification, as he had hoped that the paper would have been thus supplemented.

*Dr. Hipwell* thought that Dr. Angle's classification had simplified orthodontia; that it enabled any person to look at a case, diagnose it, and give a prognosis in a very short time, without going into any deep complicated classification such as had been put forward by others. Dr. Angle was an idealist and the classification was an ideal. It was known where the molars were and it was known where they had to be put and also why the change had to be made, and what would be the result when the operation was finished.

*Dr. Davenport* wished to echo what Dr. Solbrig had said. It was very easy, if one was not careful, to fail in diagnosing a Class II case in the temporary teeth, for the simple reason that in a great many cases the temporary lower molar was not standing in front of the temporary upper molar but either articulating straight on or even extending back. In working



especially on young children, it was very important indeed not to take it for granted that position of the teeth was a Class II case, as very often later on it would be found that it was not a Class II case and not even a case that required regulating at all.

*Dr. Chiavaro* said there were two angles distal to the second temporary molars, one an obtuse angle made from the ascending ramus of the mandible, and one very acute angle made from the tuberosity of the upper maxillary bone. Looking at the figures it would be seen that the first permanent lower molar had a direction mesially and the permanent first upper molar had a direction distally to the biting surface; so that when those two molars came together the upper molar was distal to the lower molar. If one imagined the mesial direction of the two molars, one would see how in spite of everything they must come in proper mesio-distal occlusion. *Dr. Angle* and *Dr. Stanton* would have called *Dr. Sim. Wallace's* illustration a pure Class II case. He had seen cases of temporary teeth in which the second temporary molars, upper and lower, had been extracted, and the two first permanent molars came in mesio-distal normal occlusion. At the next meeting it was his intention to show some casts illustrating the subject.

*Mr. Coebergh* said it was possible many of the members had seen the paper of *Dr. Zsigmondy*, of Vienna, read before the Medical Congress in Budapest, in 1909, and printed in the Transactions. *Dr. Zsigmondy* showed a series of photographs of skulls in adult life, and the question of the position of the first molar, according to those pictures, was not so simple as *Dr. Sim. Wallace* seemed to think. It was seen from the photographs that there was a constant difference of correlation between the position of the teeth and the place of insertion of the zygomatic bone on the upper jaw. So far he agreed fully with *Dr. Sim. Wallace* that it was necessary to study, more and more, the normal arch or nearly normal arch in order to come to a proper and more scientific classification, but that was only for scientific purposes. He should like to remind *Dr. Sim. Wallace* that *Dr. Grevers* said, in a paper read before the Columbian Dental Congress, that it was in practice best to adopt the Angle classification.

*Dr. Hecht* referred to the growth of the jaw, especially in the front of the mouth.

*Dr. Smith* said one thing about *Dr. Sim. Wallace's* paper had impressed him very much and that was, if he understood him rightly, that he took exception to Angle's Class I case, and considered that most of the time, if not all the time, the cause of the trouble was the forward movement of the first molar. That might be the case on some occasions, but certainly very often the contraction of the arch brought about a crowded condition in the front of the mouth, and it might not necessarily mean the forward movement of the teeth in any way whatever. There were many cases in which the temporary teeth had been extracted and where all the teeth came forward and the first molars could come forward and cause the condition *Dr. Wallace* had spoken of, and thereby cause a crowded condition in the mouth or an Angle Class I case. It seemed to him that classification was misleading unless the facial point of view was taken into consideration. In his opinion the facial point of view was the most important part of any classification in relation to the work of articulating the teeth. It was very necessary to look at the face and see the condition, whether superior protusion or retrusion or whether there was a comparatively good profile, as was the case many times with Class I, whereas when the work was finished there would be retrusion of both upper and lower jaw and upper and lower teeth. Certainly the classification needed most careful consideration, and many times he was confident it was misleading unless the facial point of view was taken into consideration.

*The President* gave a short synopsis of the Angle classification. In Class I the first molars, upper and lower, were in normal relation mesio-distally, or antero-posteriorly. He remembered that the normal relation of the lower first molar to the upper is that the lower first molar stands the width of one premolar in front of the upper first molar. In Class II the position of the lower first molar was distal or posterior to the upper first molar, the width of one premolar. In the typical case of Class III the first lower molar stands the width of two premolars in front of the upper first molar. After his conception, the three classes of the classification corresponded to a certain balance in the face. In the typical case of Class I the teeth were bunched in the front part of the mouth, and the dental arches, upper



and lower, needed expansion in the premolar, canine and incisor region. In correspondence to the lack of development in the front part of the jaws, there was a flat face. In the typical Class II case, there was a receding lower jaw, corresponding to the distal position of the lower first molar. In the typical case of Class III, there was the bulldog expression owing to the too-far advanced position of the lower first molar. Personally, he believed Angle's classification a scientific invention and of much practical value, and this notwithstanding it had been often attacked, in England as elsewhere, and Dr. Sim. Wallace seems foremost in opposition. Germany was perhaps the European country where it was most accepted, notwithstanding that other scientists in that country had brought forward other classifications. Judging by the pictures on the screen, he believed that Dr. Wallace had sometimes a good conception of a normal denture, but then again he believed the esteemed essayist had a wrong conception of it. The first picture shown was not of a normal denture at all; it represented an "end-to-end bite," which, according to the President's investigations in the museums of Paris and London, must be considered as distinctly abnormal for all races, not only for the white race, but also for the black and yellow races. He had to compliment Dr. Wallace on his second slide, which was explicit as to the normal position of the first molars.

Dr. de Vries said he had heard that Dr. Sim. Wallace had a classification of his own which had been published, though he had not seen it. Regarding the position of the first molar, he agreed with Dr. Smith that the question was involved in the idea of facial beauty. If an orthodontist extracted the upper bicuspid in the treatment of Class II cases, he was fulfilling his conception of what he considered a beautiful face when he pushed back the upper six anterior teeth. Also, if his work was intended to remodel the upper lip line and bring the lower weak chin forward, he was also fulfilling his conception of what was beautiful. He had never seen a case of prognathism of the upper jaw. He wished to ask Dr. Sim. Wallace if he extracted bicuspid in treating a case of that sort.

Dr. Sim. Wallace, in reply, said he knew that when he brought forward his communication it would raise something in the nature of a hornet's nest. Dr. Chiavaro seemed to think that he had some special ideas on the development of bone, but as a matter of fact he had not. He was giving the case as it had been worked out by Humphreys and Tomes and as it had been put beyond the possibility of doubt by experiments on animals. It was hardly necessary to mention the fact that the jaw was developed by the deposition of bone posteriorly and absorption of parts anteriorly, but he might mention the fact that the gradual translation backwards of the zygomatic arch was accomplished in the same way. The experiments were performed on pigs by putting little rings into the bone. When the rings were put in behind, the deposition of bone sent them still further into the bone; but when they were put in front of the ascending ramus they gradually fell out by the absorption of the bone. That showed clearly that the deposition was behind and absorption in front. As there was no such thing as interstitial growth of bone, it had to be recognized that all the bone development took place by deposition and absorption.

He had put on the screen a slide that had been twice criticized for not being in normal occlusion. He had referred to the fact while reading his paper, but for his purpose it had very little concern; he was only showing the best slide he could get at the moment, to illustrate the points he wanted to bring out. He would rather it had been a perfect occlusion but he knew that it was not. His paper dealt with mathematical considerations pure and simple; it was a matter of measurement. Admitting the possibility of measuring the teeth, or the possibility of measuring from one point to another in the mouth, the conclusion must be that which he tried to indicate, as a mathematical necessity. He was not speaking about a matter of embryology at all but of mathematical considerations and measurements.

It had been considered by one member that Angle's classification simplified matters. He had tried to show that Angle's classification simply confused. Taking a case where a tooth had been thrown out of position and the other teeth formed a complete arch, i. e., where the second premolar was one tooth too far forward, and then regulated, as was often done by a certain school of orthodontists, it simply produced double anterior protrusion of the teeth, about one of the most hideous irregularities that he knew; it was trying to get thirty-two teeth into a jaw that could only hold twenty-eight.

With regard to whether he extracted bicuspid, he certainly did so when the jaws were

not big enough to hold them. It was an excellent method and the only scientific one if the jaws were too small to hold the complete complement of teeth. Nobody had shown how the development of the jaws could be accelerated after a certain amount of development had been lost. Angle made no point in his book of trying to develop the jaws in such a way that it would be able to accommodate the teeth if there was a slight amount of crowding to commence with.

With regard to Dr. Hecht's remarks as to the front of the mouth not growing, he had left that out of consideration for simplicity. There was a very small amount of growth or deposition of bone externally and a certain amount of absorption internally, so that the teeth were somewhat translated outwards; but the amount was small and did not affect his argument and therefore he did not care to put it forward. Dr. Smith's idea with regard to the face emphasized what he had tried to bring out, that if a man went by the molar he would be going by something wrong, but if he went by the face he would be more likely to go right.

With regard to supplying a classification which was better than Angle's, he had already made two classifications. One was very a bad one, but it was better than Angle's as it had an element of truth in it and was based on facts. It might not have been useful for practical people whose sole idea of regulating teeth was whether they could be pushed forward or backwards. Angle's classification might be excellent for that. That, however, was not the science of orthodontics. Angle's classification could be put into words which would not be confusing. It should be recognized that when talking about Class I, Class II, or Class III, one was talking about occlusion, not about the relations of the dental arches or the jaws. If the occlusion was correct, one could say it was correct; if normal, it could be said to be normal. But one could not let one's words extend beyond what one was actually talking about. It was the occlusion which was said to be normal. If on the other hand it was a Class II case, i. e., if the lower molar did not occlude so far forward as it ought to occlude, then it was post-normal. If on the other hand it was too far forward then it was pre-normal, but that was occlusion, and he had no objection to the use of the words.

With regard to the jaws, the classification should be taken from that already given by anthropologists, and that could be improved upon. One of the most common faults in cases of irregularities was the fact that the jaws were subnormal, too small to accommodate all the teeth. Consequently, when speaking about the jaws, one was at liberty to speak of them as subnormal if they were so. If the upper jaw was too far forward it could be called upper prognathism, a word used by anthropologists. If the lower jaw was prognathic, why not use the word prognathic if a word must be had for it? Similarly in other cases one could use the word retrognathism or upper retrognathism. Sometimes the teeth projected somewhat more forward and that might be called anterior proclination, or if they were sloping backward it could be called retroclination. It was equally easy to make other classifications. What was required was a word that corresponded with the facts. The great fault in Angle's classification was that it was intensely misleading and that the words he used were ridiculous.

## CLASSIFICATION OF MALOCCLUSION.\*

BY MARTIN DEWEY, D. D. S., M. D., KANSAS CITY, MO.

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President of The Dewey School of Orthodontia.*

I FEEL as if I am almost compelled to offer an apology for presenting a paper on the subject of classification before this body, for you all are familiar with the subject. My reason for so doing is that I want an audience familiar enough with the subject, who can either agree or disagree with me with some degree of understanding, for the subject of classification is by no means settled and is still open as a matter of dispute. Several articles have been published in the journals recently and also one text book, in which this subject has been badly muddled. When Angle gave to the world his plan of classification, which has been almost universally accepted, it was by far the best plan of classification that had been evolved. Even at the present time, the basis of the plan is the best of any that has been advocated.

As malocclusion is simply a deviation from normal occlusion, it would be the most logical thing to classify malocclusion as it deviated from normal. The malocclusions of the teeth are spoken of in two general terms; viz., "positions of malocclusion" and "classes of malocclusion." The terms "positions of malocclusion" and "classes of malocclusion" are used more or less arbitrarily, but I find by dividing them in this manner that it is much easier to teach to students.

"Positions of malocclusion" refers to the position of the individual teeth in relation to the line of occlusion and the median line of the face. I will not take up your time in considering these, for positions of malocclusion can be readily recognized, and, except for a slight difference in terminology, there is no difference of opinion.

"Classes of malocclusion" refers to the relation of one dental arch to the other, or, we might say, the relation of the lower arch to the upper arch. We speak of the relation of the lower arch to the upper, because the lower arch is the movable arch, located on the mandible, which is a decidedly movable bone; and, as the mandible is a bone of environment, conditions which will influence the position of the lower arch and the position or development of the mandible are more liable to occur than those which will influence the upper arch and maxillæ. Classes of malocclusion, referring, as has been stated, to arch relations, can only be considered from some definite point or base. This point or basis is the normal mesio-distal or antero-posterior relations of the lower arch to the upper. The term antero-posterior is probably more correct than mesio-distal, as it is more descriptive of the conditions that we are describing.

In taking up the study of malocclusions, we find a number of cases in which the lower arch occupies a normal antero-posterior (mesio-distal) relation to the upper arch. Another group of cases would include those malocclusions in which the lower arch is posterior or distal to the upper arch. A third group would include those cases in which the lower arch is anterior or

\* From a lecture given before the Central Association of Angle Graduates, Chicago, November 9, 1914.

mesial to the upper arch. Therefore, with this plan, we can have but three groups of malocclusions, regardless of what the positions of the individual teeth may be. Formerly some discussion arose regarding a fourth class of malocclusion which many writers attempted to incorporate in this plan, but it is obvious that we could not add another group of cases under the head of 'Class IV' without destroying the very foundation of the plan.

There has been considerable misunderstanding and confusion among some writers over this simple plan. Cases have been placed in different classes by various authors, each claiming that he was following Angle's classification. The error has resulted from a misinterpretation of some of Angle's writings. The fault has not been with the plan but in the application of the plan. Also, many have taken an improper basis to argue from.

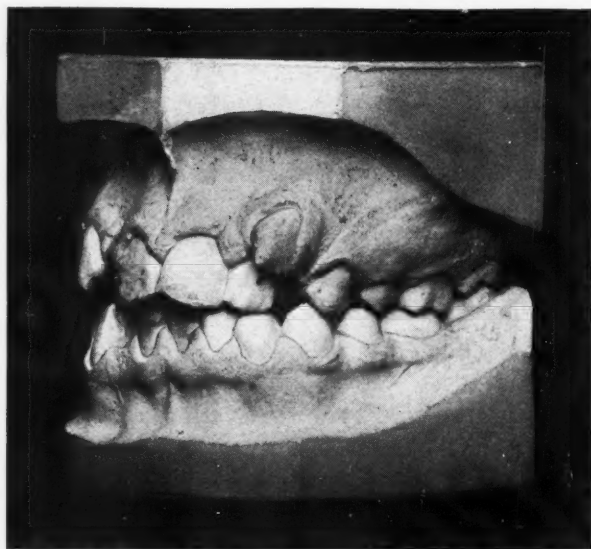
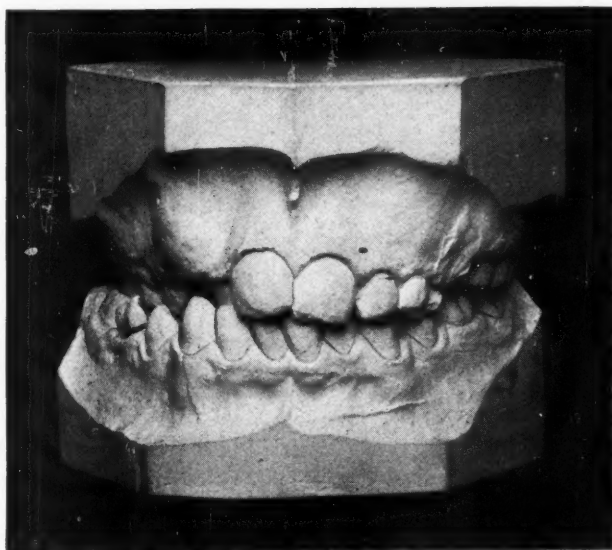


Fig. 1.—Normal antero-posterior relation of the arches, therefore Class I or neutroclusion.

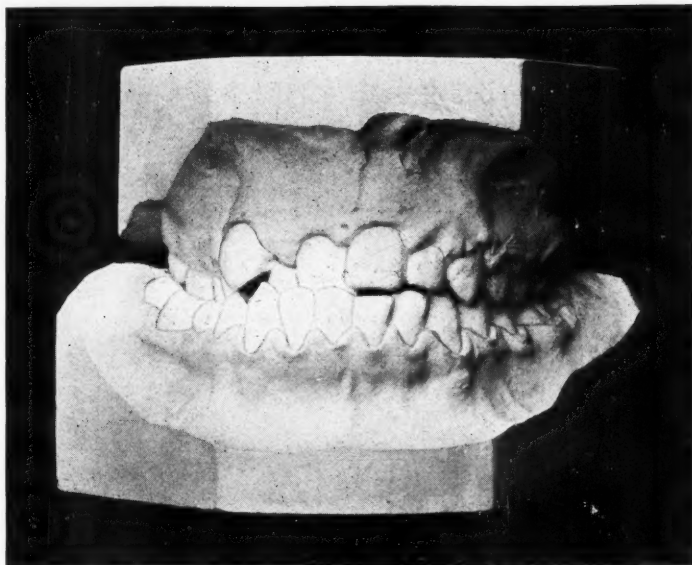
Referring to some of the writings of Angle, I will quote from the seventh edition of his work on malocclusion: "Class I is characterized by normal mesio-distal relation of the jaws and dental arches, as indicated by the normal locking on eruption of the first permanent molars, at least in their mesio-distal relations, though one or more may be in buccal or lingual occlusion." A great deal of confusion has arisen because some have only taken certain parts of the definition and have not paid enough attention to the mesio-distal relation of the dental arches. Some have taken the first molars as the basis of classification, which is very misleading. It is possible for the arches to occupy a normal antero-posterior relation and still have one or both molars in an abnormal position antero-posteriorly, as I will show later. By arch, I mean the dental apparatus as a whole. By the relation of the arches, I mean the relation of all of the teeth in one jaw to all of the teeth in the other. There are conditions which will influence the antero-posterior relation of the molars, either the upper or the lower, without changing the relation of the arches. Such cases as shown in Fig. 1 can be placed in a certain class without very much misunderstanding or argument. The normal antero-posterior



(mesio-distal) relation of the arches is indicated by the occlusion of the molars and premolars. Likewise, Fig. 2 shows two other cases in which there is a normal antero-posterior (mesio-distal) relation of the arches, with lingual occlusion of the upper molars and premolars on one side to the lowers. The lingual relation of the upper teeth to the lowers does not change the antero-posterior (mesio-distal) relation of the arches, and the cases belong



A.



B.

Fig. 2.—Normal antero-posterior relation of the lower arch to the upper, with the upper molars and premolars in lingual occlusion on one side. Class I or neutroclusion.

to Class I according to Angle's plan of classification. Fig. 3 illustrates another case of Class I, which is characterized by normal antero-posterior (mesio-distal) relation of the arches and would be placed in that class by all who are familiar with Angle's writings. All of these cases are characterized by lingual occlusion of the upper molars and premolars, the arches are spoken

of as being contracted and require a general expansion in order to make the teeth occupy the proper relation to the line of occlusion.

The treatment of all of these cases is very similar and therefore can be placed in a certain type, group, or division, because of the similarity of treatment. Fig. 4 shows another case in which we have a normal antero-posterior (mesio-distal) relation of the arches; the condition is complicated by mouth-breathing and protruding upper incisors, abnormal lip pressure, and slightly

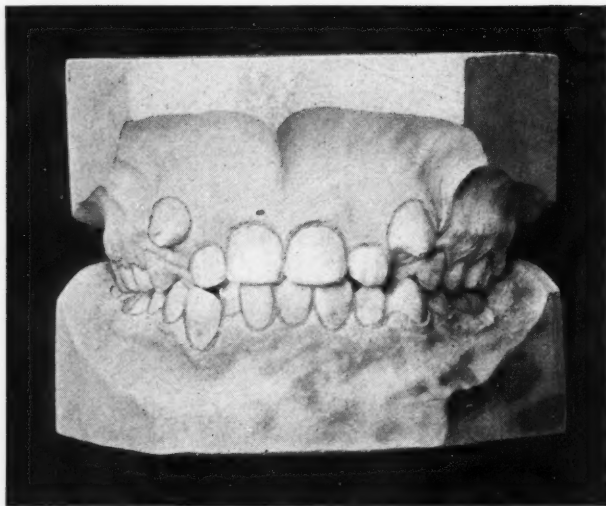


Fig. 3.—The molars and premolars of both arches are in lingual occlusion to the line of occlusion. Class I or neutroclusion.

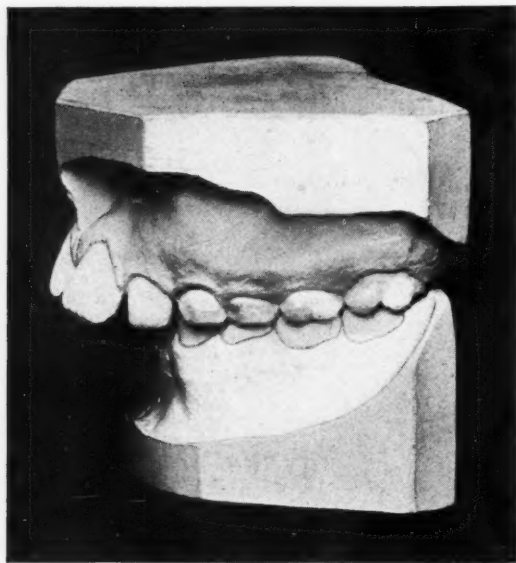
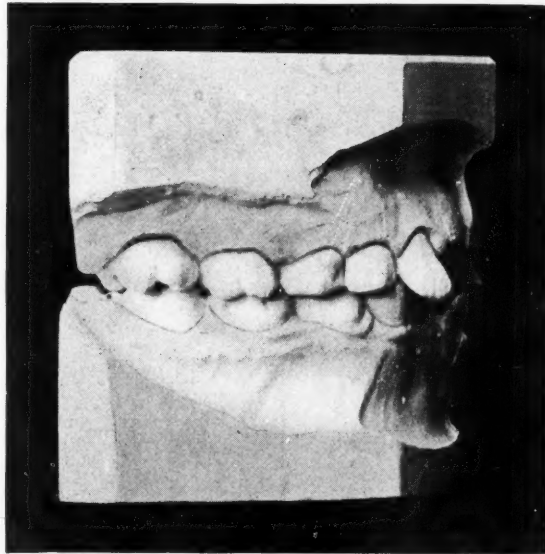


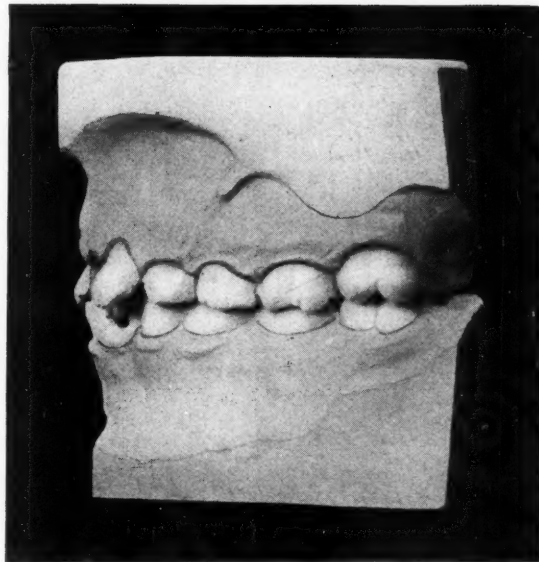
Fig. 4.—Normal antero-posterior relation of the arches; protruding upper incisors. Class I or neutroclusion.

retruding lower incisors. Some practitioners would probably place the cases of this group under Class II, but if we take into consideration the position of the deciduous teeth, it will be seen that the antero-posterior relation of the lower molars is normal to the uppers. It will be observed that the relation of the first molars is not the same as would be the case later in life, but it is normal for that age.

Fig. 5 shows another case of Class I which belongs to the first type, as general expansion of the arches is needed. In this case you will see that the mesio-buccal cusp of the upper first molar does not fall in the buccal groove of the lower first molar. This condition is described as a normal antero-posterior (mesio-distal) relation of the arches, but the first permanent



A.

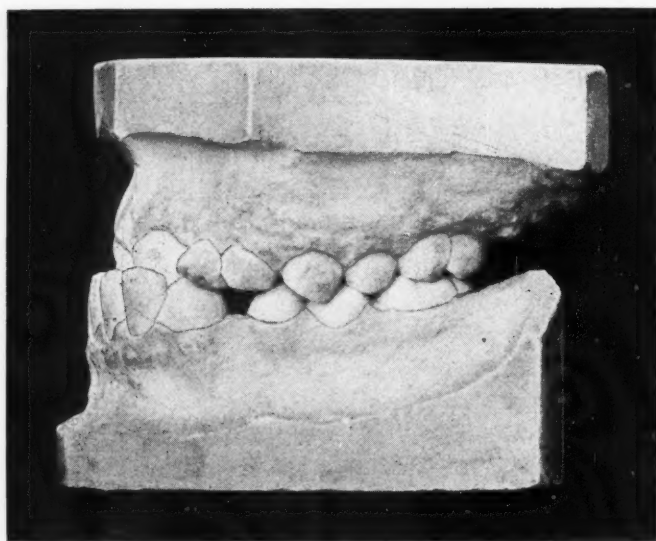


B.

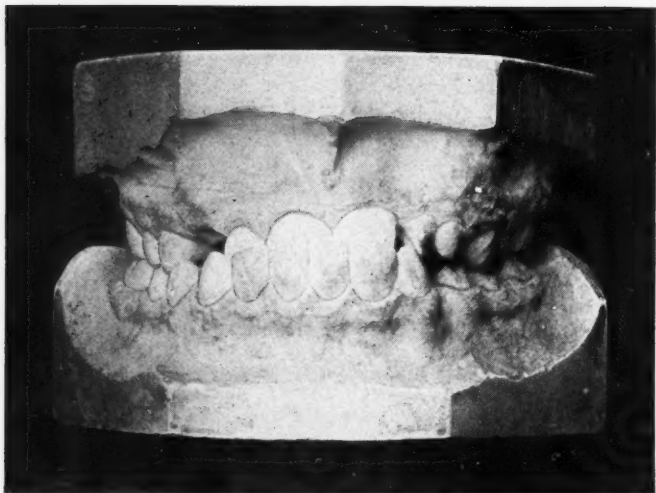
Fig. 5.—Normal antero-posterior relation of the arches, showing the position of the molars at that age. Class I or neutroclusion.

molars do not lock as they will later in life—their position is normal for that age. Several years ago Harold Chapman, of London, called attention to that position of the molars, but the profession as a whole have not given enough consideration to that condition of the teeth, and some who have based classification of malocclusion on the relation of the first permanent

molars alone, have classified and treated cases similar to the one shown in Figs. 4 and 5 as Class II, Div. 1 and 2. I am aware that any pathological conditions of the nose and throat which would induce mouth-breathing and allow the mandible to drop away from the maxillæ, would easily allow the lower molars to assume a posterior relation to the uppers. However, at this age, the relation of the molars in Figs. 4 and 5 is normal and the cases are



A.



B.

Fig. 6.—Normal antero-posterior relation of the arches with lingual relation of the upper anterior teeth. Class I or neutroclusion.

both Class I, because of the normal mesio-distal relation of the arches, even if the cusps of the permanent molars do not lock as they will later in life, if everything develops normally.

Another case of Class I is shown in Fig. 6, which presents a normal antero-posterior (mesio-distal) relation of the arches, a lingual position of the upper incisors to the lower incisors, a slight labial relation of the lower incisors to



the line of occlusion. This type of cases has been confused with Class III, and the case shown in Fig. 7 was described before a prominent society as belonging to Class III. If you will examine this case (Fig. 7) very carefully, you will see there is a normal antero-posterior (mesio-distal) relation of the arches. This type of Class I cases I have placed in a group by themselves because they demand a special line of treatment or technique, which is slightly different from the other groups of Class I.

The classification of cases which are complicated by the loss of one or more of the permanent or deciduous teeth, has led to considerable confusion. This is especially true of cases in which the first permanent molar is lost early and the practitioner has been taking the first permanent molar as the basis of classification. You will begin to see how much better it is to base your classification on the dental arch as a whole rather than upon any one tooth. I have great respect for the first molar as an organ of mastication, and they are very necessary in producing normal occlusion, but as a basis of classifi-

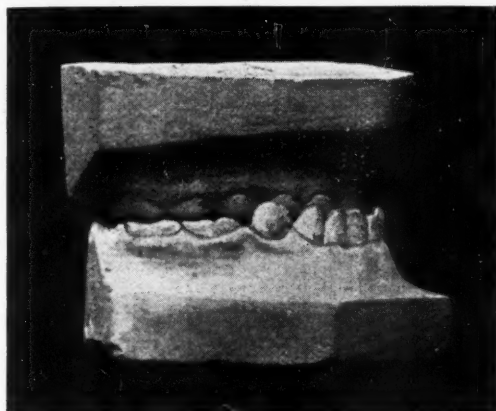


Fig. 7.—Normal antero-posterior relation of the arches. Class I or neutroclusion, which has been called Class III.

cation, when taken alone, I have not much respect for them, as they are as liable as any other teeth to assume an abnormal position under certain conditions.

The type of cases shown in Fig. 8 are mutilated cases of Class I. The loss of the lower first permanent molar has allowed the lower second and third molars to drift forward, and the premolars and canines have drifted distally. The upper first molar was taken out at a later period and consequently the upper teeth have not drifted as much as the lower teeth. After the lower premolars and canines drifted distally, the upper premolars and canine locked in an abnormal occlusal fossa, and have been prevented from drifting distally so as to close the space made by the loss of the upper first molar. If the lower first molar was in position, we would have all of the teeth occupying their proper relation to each other; therefore the arch relation is normal, and the case is a mutilated case of Class I.

The premature loss of the deciduous molars has produced a type of malocclusion which has caused more discussion as to the proper plan of classification than any other type. Fig. 9 shows a case about six and a half years of age, in which there has been an early loss of the upper deciduous molars.

On examination, we find that the upper canine occupied its proper antero-posterior (mesio-distal) relation with the lower canine and the first deciduous molar. The lower teeth from the canine posteriorly are also in their proper position. Therefore, the lower deciduous canine and deciduous molars, the

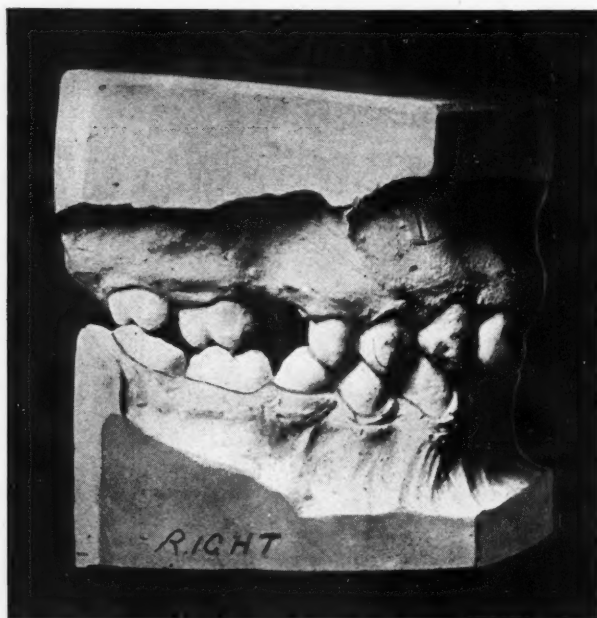


Fig. 8.—Loss of upper and lower first molars, producing a mutilated case of Class I or neutroclusion.

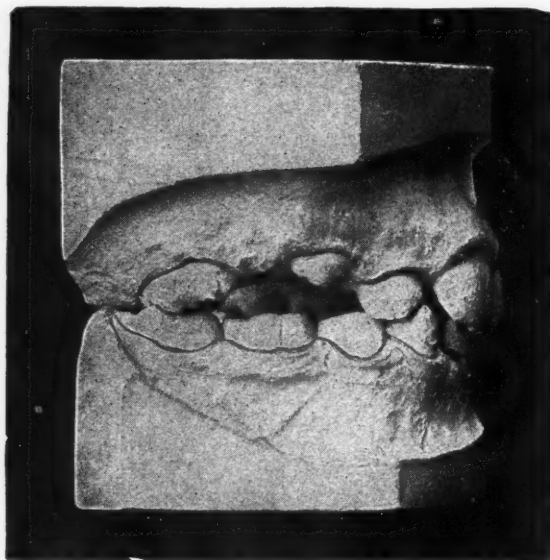
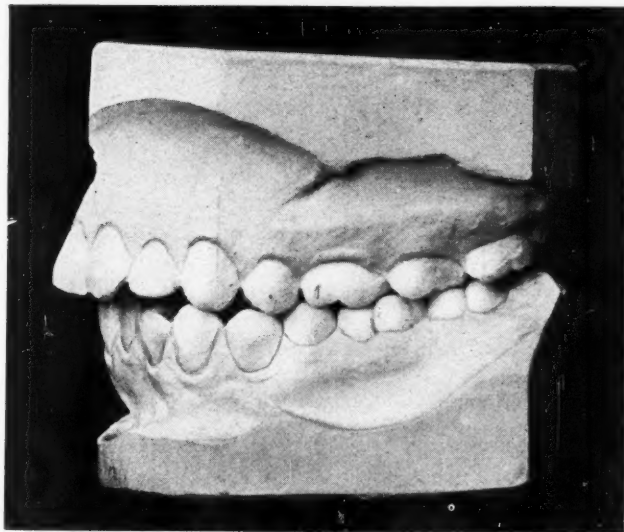


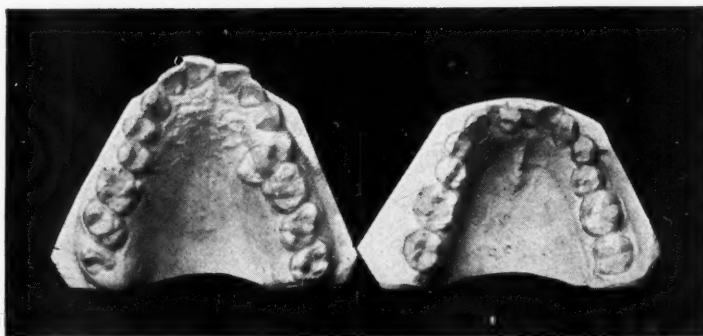
Fig. 9.—Early loss of second deciduous molar; mesial position of the upper permanent molar; normal antero-posterior relation of the arches. Class I or neutroclusion.

first permanent molar, and the upper deciduous canine and first premolar are the only teeth in the right side of the mouth which occupy the proper antero-posterior (mesio-distal) relation. The position of the upper first molar and incisors has been interfered with by the early extraction of the deciduous molars and incisors; consequently those teeth can not be considered as occupy-

ing their normal position, either to the teeth of the upper arch or to the lower arch. Therefore, the lower permanent molar and the deciduous molars and canine, occupying their proper antero-posterior relation to the only teeth in the upper arch (canine and first premolar), which have not been disturbed by extraction, are in normal antero-posterior relation to the upper arch, and the case is one belonging to Class I. The upper first molar has drifted forward and occupies a mesial or anterior relation to the lower first molar and to the teeth of the upper arch. If the classification of malocclusion was



A.



B.

Fig. 10.—Normal antero-posterior relation of the arches; mesial position of the upper molars. Class I or neutroclusion.

based on the position of the first molars, it would be easy to make a wrong diagnosis of this case. It is a fact that the upper first molar is mesial to the lower first molar, but the lower first molar is not distal to those teeth in the upper arch which are normal; in other words, the lower molar does not occupy an abnormally posterior position to the upper arch. Fig. 9 would therefore be described as a case which has normal antero-posterior (mesio-distal) relation of the lower arch to the upper, mesial position of the upper first molar, and belongs to that group of cases known as Class I.

Owing to the mesial position of the upper first molar, some have placed

this kind of cases in Class II. Class II is characterized by a posterior (distal) relation of the lower arch, and if the lower arch was distal, the upper canine would not occupy the relation it does in Fig. 9, which is normal antero-posteriorly.

Fig. 10 shows an older case than Fig. 9, but it is very probable that the same conditions existed in Fig. 10 at the age of six and a half as is shown in

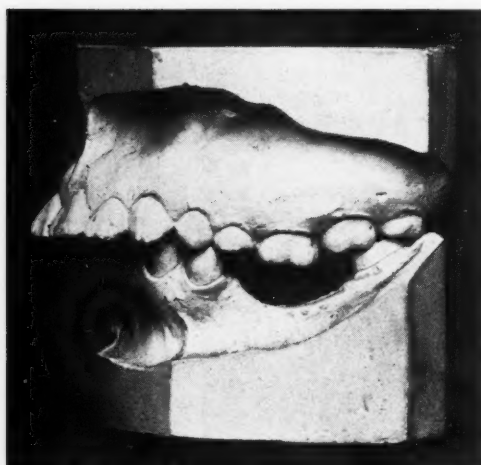


Fig. 11.—Loss of lower second premolar; first and second molar has produced a mutilated case of Class I or neutroclusion.

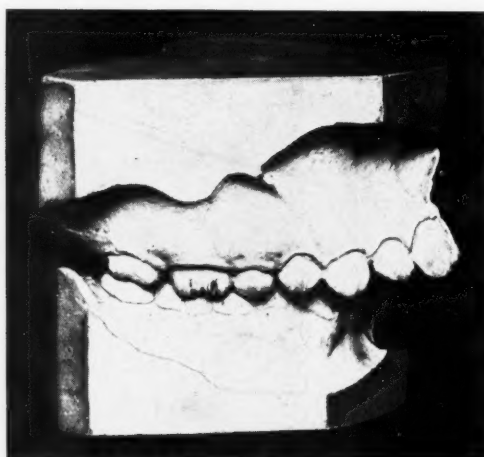


Fig. 12.—Posterior (distal) relation of the lower arch; protruding anterior teeth. Class II, Division 1, or distoclusion.

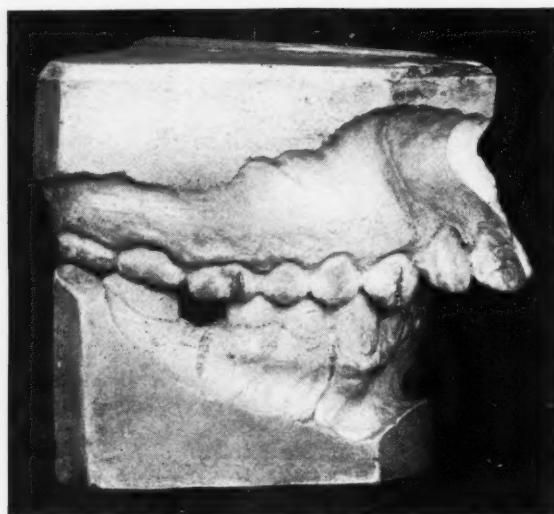


Fig. 13.—Loss of lower first molar; posterior relation of the lower arch; protruding anterior teeth. Mutilated case of Class II or distoclusion.

Fig. 9. By looking at the occlusal view, you will see that the left second upper premolar occupies a lingual position to the line of occlusion. By examining the upper first premolar and the canine, you will see that these teeth occupy a position antero-posterior relation with the lower canine and premolars. Owing to a slight torsi-occlusion of the lower first premolar, the upper canine is not in normal occlusion, but it falls in the influence of the proper inclined planes. The upper first, second and third molars occupy



an anterior (mesial) relation to the lower molars and to the upper teeth. This case is also a Class I, in which we have a mesial relation of the upper molars, and not a distal relation of the lower arch. If the lower arch was distal, the upper first premolar and canine would not occupy the relation to the lower teeth that they do. In treating this case, we would not move the lower arch forward, neither would we move the upper arch backward, but we would move the upper molars posteriorly (distally) and make room for the upper second premolar which is now lingual to its proper position. Therefore, classification is based on the antero-posterior relation of the arches

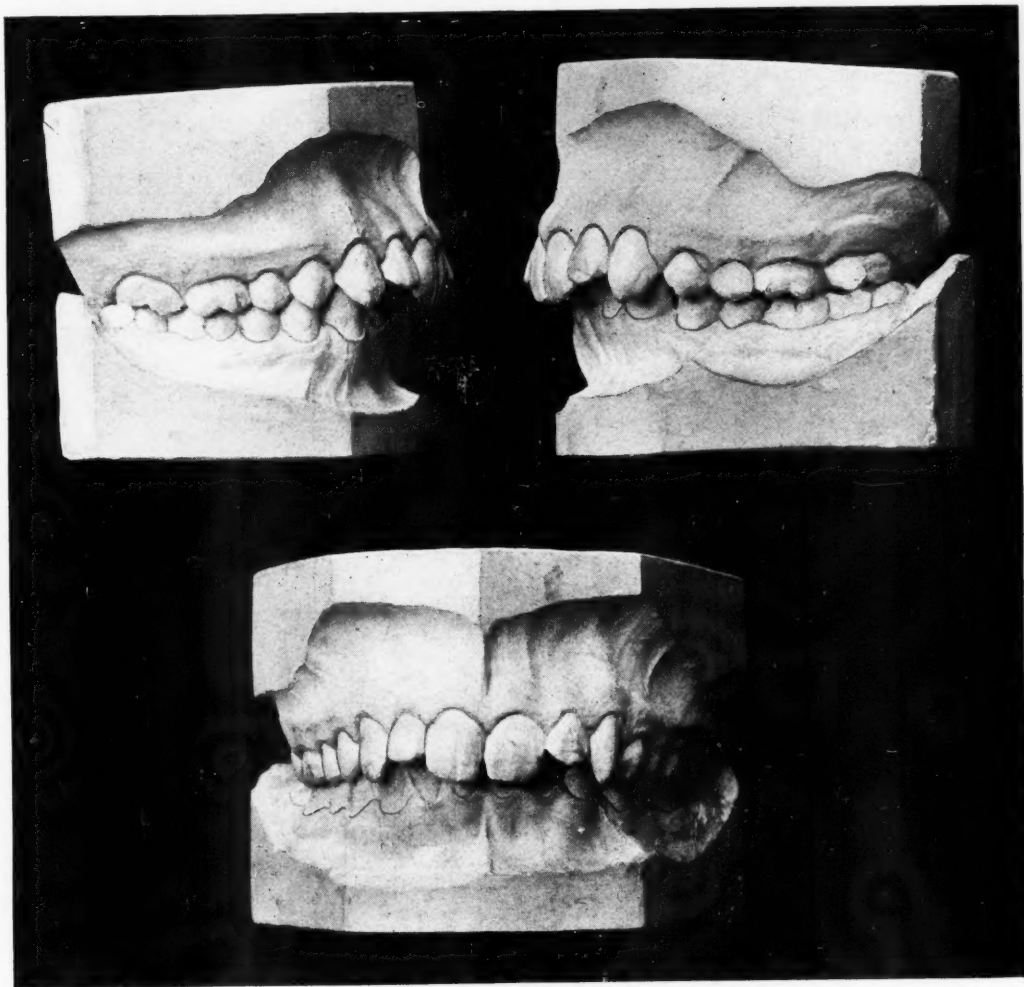


Fig. 14.—Posterior relation of the lower arch; bunched anterior teeth. Class II or distocclusion.

and not on the relation of the first molars. To simply diagnose malocclusion from the molars alone will greatly confuse the treatment of cases so far as each class is concerned.

Another very interesting case which has been complicated by extraction is shown in Fig. 11. The patient was so unfortunate as to lose the lower second premolar and first and second molars on both sides. As a result of the loss of these teeth, which destroyed the approximal contact, the lower anterior teeth—incisors, canines and first premolars, have drifted distally

and have also been forced distally by the abnormal action of the lips, and the third molar has drifted forward. This case is very similar in facial appearance to Class II, Division 1, and it requires a very close study of the case in order to distinguish it from Class II, Division 1. If the position of the lower third molar is noted, it will be seen that it occupies an anterior (mesial) relation to its normal position. As Class II cases are characterized by a posterior (distal) relation of the lower arch, this case (Fig. 11) could not be called Class II. A study of the lower anterior teeth show them to be

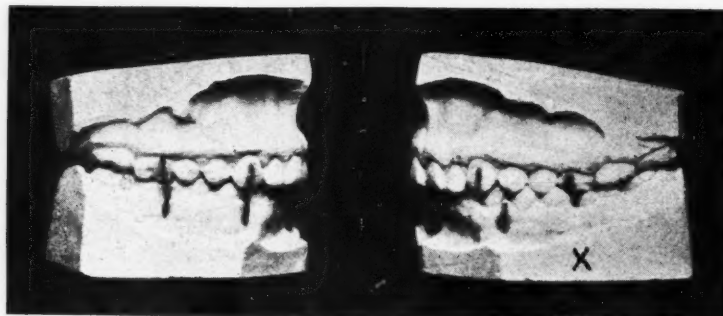


Fig. 15.—Mutilated case of Class I or neutroclusion, which has been incorrectly classified as Class II, Division 2.

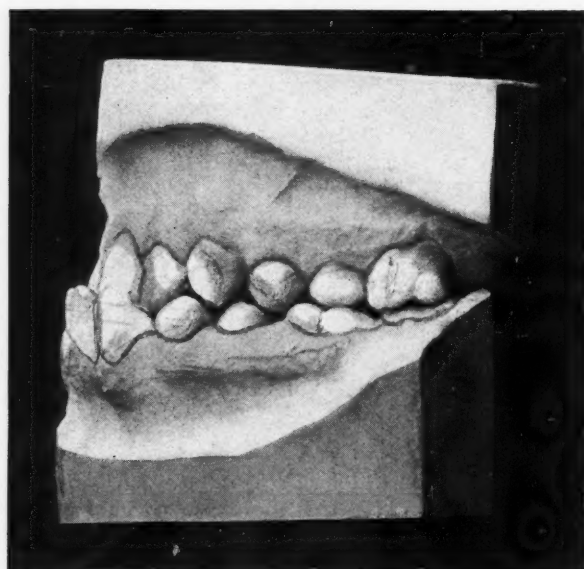


Fig. 16.—Anterior relation of the lower arch, making a Class III case or mesioclusion.

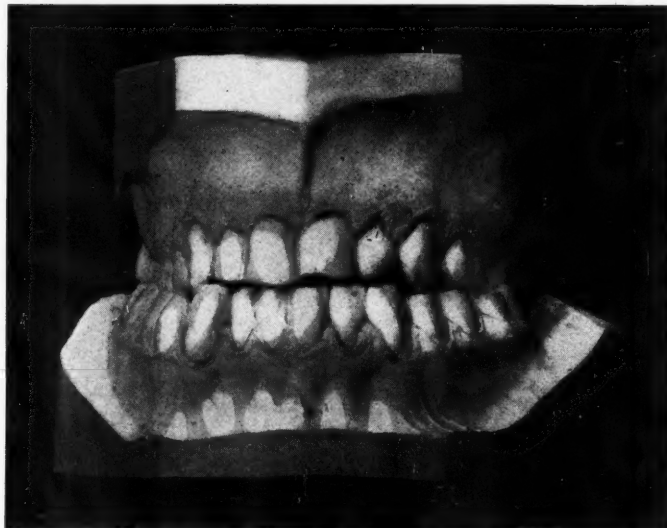
distal, but you have no right or reason for basing your classification on the anterior teeth any more than you have for basing the classification on the third molar; and if classification was based on the lower third molar, we would have to admit that it was anterior (mesial), making a Class III case. Therefore, the logical thing to do is to resolve it back to what it was before the teeth were extracted, and by restoring the missing molars and premolars we would have each tooth in its proper antero-posterior position, which would cause us to classify Fig. 11 as Class I, mutilated.

Class II cases are those which are characterized by posterior (distal)

relation of the lower arch to the upper. They have been divided into two divisions, one division including those cases shown in Fig. 12, which are characterized by narrow upper arch, protruding upper incisors, receding lower anterior teeth, abnormal muscular pressure, under-developed mandible, and abnormal breathing. Fig. 13 shows a mutilated case of Class II,



A.



B.

Fig. 17.—Anterior relation of the lower arch. Class III or mesiocclusion.

which presents very much the same appearance as Fig. 11, and it is only by examining carefully the position of the second molars that you will be able to place the case in its proper group. The loss of the lower first molar has allowed the second molar to drift forward, but even in its drifted position, the tooth still occupies a position posterior (distal) to its normal mesio-distal relation. The premolars and canines below are in a distal position

but have been held by the force of the inclined plane from drifting any farther distally; but in their present position, they are slightly more distal than they would have been had the molar not been lost. Therefore, Fig. 11 and Fig. 13 belong to different groups. Fig. 11 is a mutilated case of Class I and Fig. 13 is a mutilated case of Class II, Division 1.

Class II, Division 2 cases are those which are characterized by posterior (distal) relation of the lower arch and bunched or retruding teeth as shown in Fig. 14. The characteristics of these cases seem to be very clear, nevertheless they have been greatly confused with mutilated cases of Class I, as is shown in Fig. 15. This slide is made from a cut shown in a recent textbook published for use in dental colleges. The writer describes the case as follows: "This case of Class II, Division 2 was caused by the loss of the lower first permanent molar at the age of eleven, thus allowing the bicuspid, cuspids and incisors to drift back the width of a bicuspid tooth, which nearly closed up the space made by the loss of the lower molar." The loss of a lower first molar never caused a Class II, Division 2 case. Class II, Division

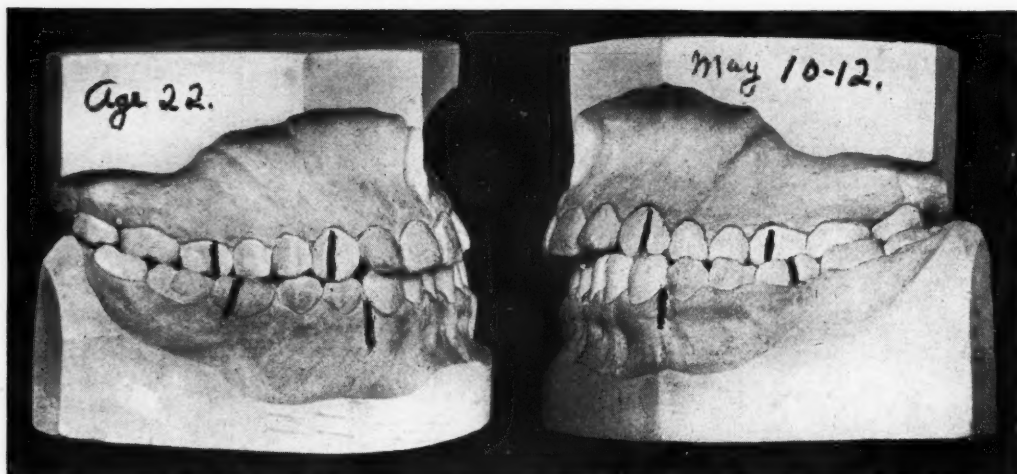


Fig. 18.—The lower arch is anterior on one side and posterior on the other. Mesiocclusion on the right side and distocclusion on the left.

2 is characterized by distal relation of the lower arch; the loss of a lower first molar will not make the lower arch occupy a distal position, but only makes the teeth anterior to the missing tooth assume a distal relation to the upper teeth. If you will examine the position of the lower second and third molars in Fig. 15, you will see that they are mesial, that is, they have drifted slightly forward to their proper relation to the upper teeth; therefore, if the lower second and third molars are anterior (mesial) or even normal antero-posterior, how can the lower arch be distal, and the case Class II? The trouble and confusion has resulted in the classification of Fig. 15 being based on a few of the teeth, instead of upon the entire dental arch.

Class III cases are those which are characterized by an anterior or mesial relation of the lower arch to the upper, as shown in Figs. 16 and 17. Class II and III both possess subdivisions, or what would better be called subclasses, which are characterized by the characteristics of the class on one side and normal antero-posterior relations on the other.



If arch relations are based on the antero-posterior relation of the arches, it is easy to see that we can have but three classes. We can have a subdivision or subclass in cases which are characterized by either anterior or posterior relation, but we can not have a "fourth class". There has been considerable discussion in former years about a possible "fourth class", in which the writers referred to such a case as shown in Fig. 18, which is a case that is mesial on one side and distal on the other. Fortunately, this case is not complicated by the loss of any teeth, therefore it cannot be charged to the "result of extraction." Each side of the lower arch occupies a different abnormal position. The side of the arch which is distal or posterior has the characteristics of Class II, the one which is mesial takes the characteristics of Class III. Therefore, instead of calling this a "Class IV" case it should be described as a unilateral anterior and posterior relation of the lower arch, or a posterior relation of the left side and an anterior relation of the right side. To have four classes would destroy the entire scheme of classification and there could be no logical reason of a Class IV group.

The criticism which has arisen in regard to classification has occurred because some have based the classification upon one or two teeth instead of upon the arch as a whole. I do not believe that any better scheme or plan can be used than to divide malocclusion upon the antero-posterior (mesio-distal) relation of the arches. However, the arch as a whole must be taken as the basis and not any one tooth. After you have done this it will be only a question of terms and call them what you will, you will find that each and every case of malocclusion will fall in one of three groups, which will therefore simplify teaching and treatment to a great extent.

## CURRENT LITERATURE

EDITED BY H. C. POLLOCK, D. D. S.

### Mendelism and Its Meaning.

In discussing "Mendelism and Its Meaning" (LeRoy H. Harvey, Ph.D., Western State Normal School, Kalamazoo, Mich., Journal of the Michigan State Medical Society, December, 1914), to quote in full:

Heredity is an universal and fundamental biological principle determining the general resemblance of offspring to parent. Variation, natural elimination and heredity constitute the Trinity of Biogenesis, in other words, they are the underlying causal factors of evolution. So totally inclusive is the domination of heredity that when we attempt to analyze its *modus operandi* in any specific case our knowledge serves to lead us scarcely to the border of a great *terra incognita*. However, we need not wail the battle-cry of the agnostic! Sometime, and I believe soon, the pioneers of biological science will traverse this unknown world and formulate it in language so clear, so plain, that "he who runs may read." We can! We must know! Who of us dare set limitations to the capacities of the human mind?

Inheritance, on the other hand, is the phenomenon of the transmission of specific characters. Here, we are on safer ground, yet at once find ourselves in the vortex of profoundest biological research. The biologist no longer views the individual as a whole, as a blend, but on the contrary, as an aggregate of distinct characters. These constitutional entities are designated "unit characters." What the atom is to the chemist, the molecule to the physicist, the unit character is to the biologist; and just as the atom and molecule are distinct, so we find no transitions between unit characters. They are specific and independent entities. These qualitative entities are however subject to quantitative variation but always within determinate limits. They are thus potentially immortal. Under the influence of unknown environic forces and at rare intervals certain unit characters may however become mutable and suffer mutational change thus producing new unit characters and contributing new materials to the process of evolution.

This conception of the organism as a complex of unit characters and individuality as the expression of a particular aggregation of such characters forms perhaps one of the most fundamental postulates in the realm of philosophical biology, as out of it has come our most recent theory of evolution and upon it firmly rests the law of plant and animal breeding and the science of eugenics. Recognition of the far reaching significance that organisms are a consequence of genetic processes and that their powers and faculties are fixed in their physiological origin is recent even among biologists. The laity, with few exceptions, are shrouded in medieval superstition. "Historians debate the part of the human species, and statesmen order its future as if the animal man, the unit of their calculations, with his vast diversity of powers, were a homogeneous material, which can be multiplied like shot." The sociologist with sincerity propounds solutions for the present and future ills of society and the field of education is perennially green with pedagogical

theory and practice. Man may propose but natural law continues to dispose. The profession of medicine is not wholly free from censor in its practice and ethics. In its zealous effort to save life it has contributed in no small measure to racial decline. Let us not blind ourselves with our humanitarianism. A decreasing infant mortality and an increasing longevity is no index of racial advancement. "The reason for this neglect lies in ignorance and misunderstanding of the nature of variation; for not until the fact of congenital diversity is grasped, with all that it imports, does knowledge of the system of hereditary transmission stand out as a primary necessity in the construction of any theory of evolution, or any scheme of human polity."

Unit characters are the materials of inheritance and the students of heredity are striving to analyze organisms and segregate desirable unit characters to the end of synthesizing them in a next generation to the esthetic, economic and social welfare of mankind. Scientific breeding has thus be-

**PAIRS OF UNIT CHARACTERS  
PISUM SATIVUM—MENDEL.**

1. **ROUND** or angular seed.
2. **YELLOW** or green cotyledons.
3. **GREY** or white seed coat.
4. **INFLATED** or wrinkled seed pods.
5. **GREEN** or yellow unripe pods.
6. **AXIAL** or terminal flowers.
7. **TALL** or dwarf stems.

Fig. 1.—Pairs of unit characters used by Mendel in his epochal experiments in plant hybridization.

come at will a process of analysis by which we may judge the number and nature of unit characters composing an individual or of synthesis by which we may create new individuals with the desired unit characters. These facts thus obtained furnish a series of biological reactions, revealing the constitution of living things. The constitution of an organism is the key to its behavior, its potentialities and its limitations, to what it may become and what it may produce. Such biological analysis, especially in the case of man, will be long and tedious. But when we view the imposing superstructure of chemistry reared in scarce a century upon the concept of the indestructable atom and note the far reaching application of Mendelism made in the last decade we feel confident that, though the time element will be longer, the result to society will be a no less imposing science resting firmly upon this conception of organic constitution.

To the masterful mind and marvelous researches of the Austrian monk, Gregor Johann Mendel, do we owe this modern conception of unit characters. His essay "Experiments in Plant Hybridization" which was presented in 1865 before the Natural History Society of Brunn marks a great biological epoch. Preceded by marvelous clarity in analysis of the problems involved and much preliminary experimentation he finally selected *Pisum sativum* and seven pairs of characters. (Fig. 1.) After eight years of arduous labor

his results were presented in the above thesis, which for clarity, logical development and expository skill has scarcely been equalled.

"The Origin of Species", six years previous (1859), had as if by magic captured the interest and focused the activity of the biological world along lines which held promise of far greater productivity than the tedious labor of experimentation in plant and animal breeding. As a consequence Mendel's

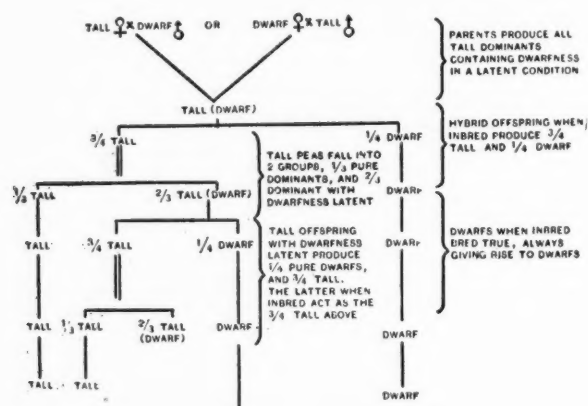


Fig. 2.—Diagram showing the inheritance of tallness and dwarfness in peas according to Mendel's Law. (From Hegner after Thompson).

work sunk into oblivion. The one man, Nageli, who might have interpreted his result to the world failed entirely to appreciate their far reaching significance. It was only after thirty-five years that the simultaneous rediscovery (1900) by De Vries, Correns and Tschermak of the same law that Mendel's work came to light and to its merited recognition.

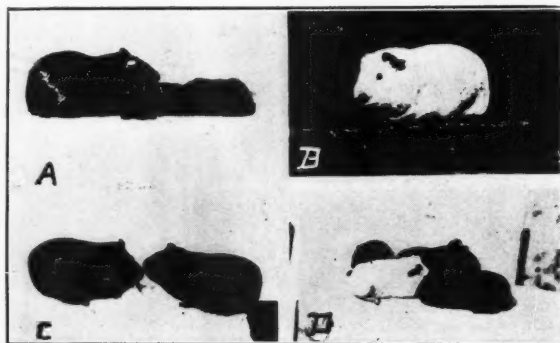


Fig. 3.—(a) A pure black female guinea-pig and her young. (b) A pure albino male guinea-pig. (c) Two mature young of a pure black with a pure albino guinea-pig. (d) A group of four young produced by animals shown in (c). (After Castle).

I may now illustrate the Mendelian Law by the analysis of a specific case. If we cross a pure tall pea with a pure dwarf pea (Fig. 2) (and it matters not which way we make the cross) the offspring will all be tall. Now if we cross two individuals of this F<sub>1</sub> generation, the F<sub>2</sub> generation yields a result unexpected, for it consists of both tall and dwarf offspring and in a ratio of 3:1. If the dwarfs of the F<sub>2</sub> generation are now inbred the result is dwarf offspring and so on generation after generation. In other words the dwarfs in the F<sub>2</sub> generation were pure like the dwarf grandparent. If the



75 percent of tall peas in the  $F^2$  generation are now inbred they resolve into two kinds of plants; one-third are found to be pure tall like the other grandparent while the other two-thirds are found to yield in the  $F^3$  generation 75 percent tall and 25 percent dwarf; in other words they are hybrid like the  $F^1$  generation. It is thus obvious that the  $F^2$  generation is to be correctly symbolized by the ratio 1:2:1 in which 25 percent are pure tall like one grandparent, 25 percent pure dwarf like the other grandparent and 50 percent are hybrids. This is the famous Mendelian ratio.

Case	One Parent	Other Parent	Offspring	Characteristics of Offspring
1	PP	PP	PP, PP	All with pigmented iris (brown-eyed)
2	PP	Pp	PP, Pp	All pigmented, but half simplex.
3	PP	pp	Pp, Pp	All pigmented and all simplex.
4	Pp	Pp	PP, Pp, Pp, PP	$\frac{1}{4}$ duplex pigmented; $\frac{1}{2}$ simplex; $\frac{1}{4}$ unpigmented (blue-eyed)
5	Pp	pp	Pp, PP	$\frac{1}{2}$ simplex; $\frac{1}{2}$ unpigmented (blue-eyed)
6	pp	pp	pp, pp	All unpigmented (blue-eyed)

Fig. 4.—Inheritance of brown and blue eyes in man. PP indicates homozygous brown eye; pp homozygous blue eye; Pp heterozygous brown eye. (After Davenport).

This law can again be illustrated by crossing pure black and pure albino guinea pigs. (Fig. 3.) The  $F^1$  generation is black. Thus blackness is dominant and whiteness recessive. The  $F^2$  generation resulting from inbred  $F^1$  individuals consist of 75 percent black and 25 percent white guinea pigs. Inbreeding of the  $F^2$  individuals shows the composition of this generation to be 25 percent pure black, 50 percent hybrid black and 25 percent pure white and so conforms to the Mendelian ratio of 1:2:1.

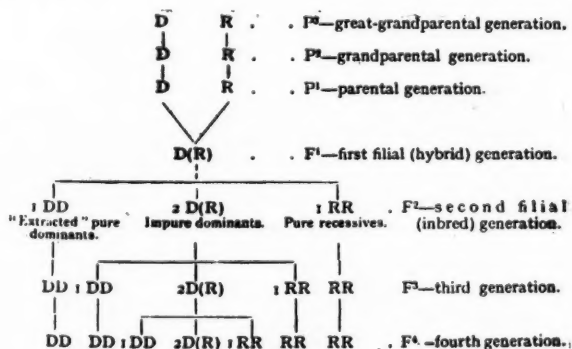


Fig. 5.—Theoretical interpretation of Mendel's Law. (After Thompson).

One other example must suffice, though hundreds might be submitted, and I take this from Hursts' study of the heredity of eye-color in man (Fig. 4). Brown eye is dominant over blue eye so that if we cross a pure brown-eyed individual with a pure blue-eyed individual the children will all have brown eyes, but hybrid in nature. If individuals both with hybrid brown eyes marry then the children will exhibit eyes of three types: pure brown like one grandparent; hybrid brown like the parents and pure blue like the other grandparent and if a sufficient number of cases are collected they will be found to occur in the ratio of 1:2:1 as can be readily seen from a study of cases number three and four in Fig. 4.

The above schematic table (Fig. 4) will also serve to make clear what is embraced in the terms "pure" and "impure." If the offspring receive two doses of the same unit character, one from each parent, as in cases one and six it is said to be duplex or homozygous, i.e., pure as regards this specific character. If on the other hand the offspring receives any unit character in a single dose, i.e., from only one parent; as in case three, the  $F^1$  generation is said to be in respect to this particular character simplex or heterozygous (impure, hybrid). Consequently long lineage is in no sense an earnest of purity of breed. Since purity of breed as regards any unit character (the term is meaningless in any other application) is a question of gametic constitution one generation suffices as well as a hundred to bring this to pass, a fact unknown to the majority of breeders who still labor under the superstition that length of pedigree is a guaranty of purity. Obviously this misconception rests upon ignorance of unit characters and gametic segregation.

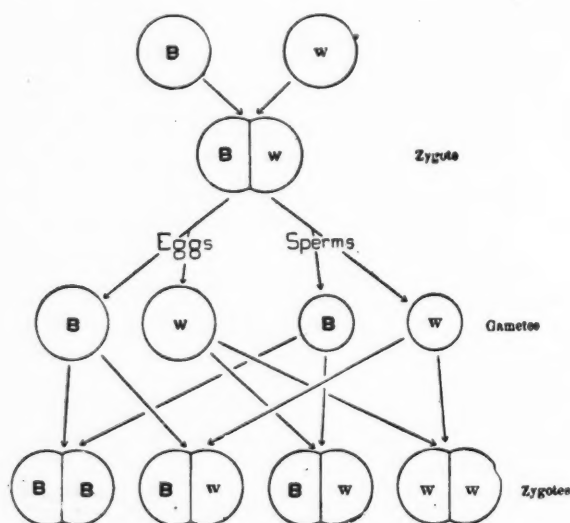


Fig. 6.—Diagram to explain the results shown in Fig. 3. *B*, represents the genetic factor blackness; *w*, the genetic factor whiteness. (After Castle).

With these facts now before us we may proceed to the consideration of the hypothesis of their interpretation (Fig. 5). It is already established in the case of the guinea pig, that blackness and whiteness are designated unit characters and that they are alternative to each other, hence constitute an allelomorph pair. It is also clear that in the  $F^1$  generation that blackness masks whiteness whence the former is designated dominant and the latter recessive. The integrity of the recessive unit character is established by its extraction in pure form in the  $F^2$  generation as it is clearly shown in the above scheme (Fig. 5). Parenthetically it may be stated that dominance though usually manifest, is in no respect an essential feature of Mendelism.

To account for the behavior of these unit characters in inheritance Mendel postulated that each was represented in the gametes by some minute body which we now designate a determiner or genetic factor (Fig. 6). To explain the  $F^1$  generation it is only necessary to assume the meeting of the genetic factors of blackness and whiteness in fertilization and the domi-

nance of the former. The  $F^2$  generation however presents a more intricate problem. To meet this, Mendel assumed that the determinants of the two members of an allelomorphic pair can never exist in the same gamete at the same time, that is, the gametes are always pure as regards the members of an allelomorphic pair. Each gamete will contain one or the other, but never both. But the zygote in each case would contain both, so there must be at gametogenesis a segregation of the determinants resulting in pure gametes of each kind and produced in equal numbers in each sex. To state this in Mendelian phraseology: the male and female would each produce an equal number of gametes one-half of which in each sex would bear the dominant determinant, the other half the recessive determinant. This concep-

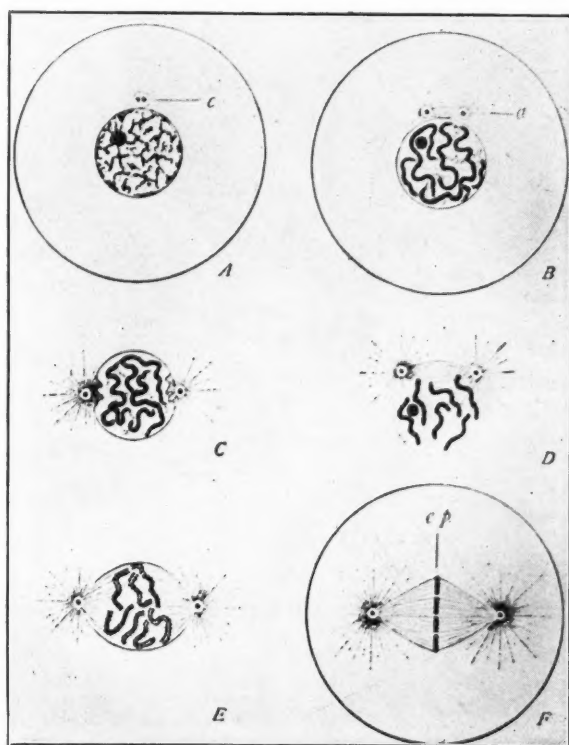


Fig. 7.—Diagram showing early stages of mitosis in soma. A, Nucleus showing chromatin on reticulum. B, the spirem. C, later state of spirem. D, chromosomes. E, later state of D. F, chromosomes arranged at equatorial plate of spindle. (After Wilson).

tion of gametic segregation is the fundamental fact of Mendelism. When one pauses to recall that nothing of cell cytology was known in 1865 the genius of this hypothesis seems scarcely short of divine inspiration. It is now obvious that in amphimixis (fertilization) with random fusion of gametes in sufficient number that the ratio of 1:2:1 must follow in the  $F^2$  generation according to the law of combinations.

When the triple rediscovery of the Mendelian ratio was announced in 1900 much cytological knowledge was at hand. The behavior of chromosomes in cell mitosis, spermatogenesis and fertilization were well understood and the Mendelian hypothesis was given the severe test of cytology with absolute substantiation at all points. The following series of figures will serve to make clear the cytological basis of Mendel's hypothesis.

May I first briefly recall to mind the process of mitosis as it occurs in the soma (Fig. 7). Within each nucleus is found a granular substance, *chromatin*, distributed over a net-work or reticulum. As each somatic cell approaches division these chromatin granules become arranged in a long thread or spirem. Shortly this spirem undergoes a definite number of transverse divisions (specific with each species) producing a fixed number of *chromosomes* which become arranged in an equatorial plate on the spindle fibers and here suffer (Fig. 8) longitudinal equipartition. The spindle fibers shorten, pulling these daughter chromosomes poleward where they join end to end breaking up into a granular reticulum in the daughter nuclei. It is evident that each of these must possess approximately one-half the nuclear substance of the mother nucleus.

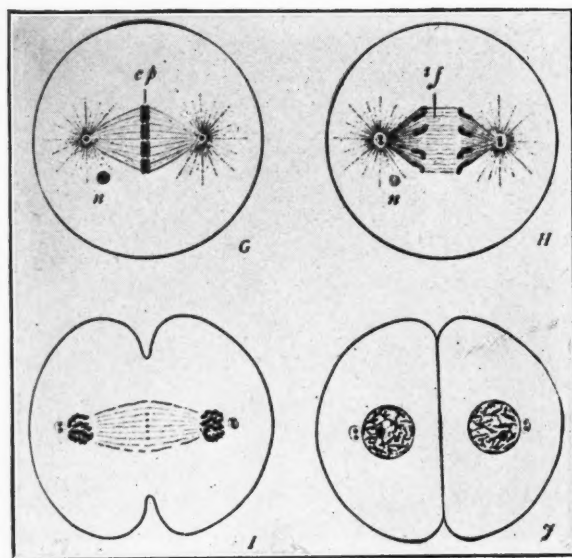


Fig. 8.—Diagram showing late stages of mitosis in the soma. G, longitudinal equipartition of chromosomes. H, chromosomes traveling poleward. I, chromosomes joining end to end. J, chromatin in reticulum of the two daughter nuclei and formation of two daughter cells. (After Wilson).

The pertinent features of this process may be summarized: (1) The fixed specific number of chromosomes; (2) Mitosis characterizes all divisions from fertilized egg (zygote) to maturation divisions in gametogenesis; (3) Chromosomes constitute the physical basis of inheritance, i.e., they constitute the mechanism of transfer of the genetic factors; (4) Equivalent distribution of chromatin into the daughter nuclei in mitosis; (5) The spirem can be demonstrated to consist of two parallel threads, one paternal, the other maternal in origin which are separated by the longitudinal division of chromosomes at the equatorial plate in mitosis. This leads to the conception of the integrity of paternal and maternal chromosomes throughout somatic mitosis.

We may now consider gametogenesis as shown in *Ascaris* (Fig. 9). Early in any ontogeny the germplasm is isolated from the somatoplasm constituting the primordial germ cells. By mitosis these multiply forming the gametogonia. Certain of these gametogonial cells undergo a period of growth forming the primary gametocytes. To this point all mitoses



have been typical showing the somatic number of chromosomes which is four in *Ascaris*.

When the primary spermatocyte prepares for division the process is radically different. The four chromosomes become organized into two tetrads which come to lie in the equatorial plate. These now separate into two dyads which move to the poles. A wall comes in and we have the two secondary spermatocytes. These at once divide simultaneously in which process the two dyads in each separate into two monads and with the appearance of dividing walls four spermatids, each possessing two chromosomes, are formed. Each later produce a single spermatozoon carrying the reduced number (2) of chromosomes.

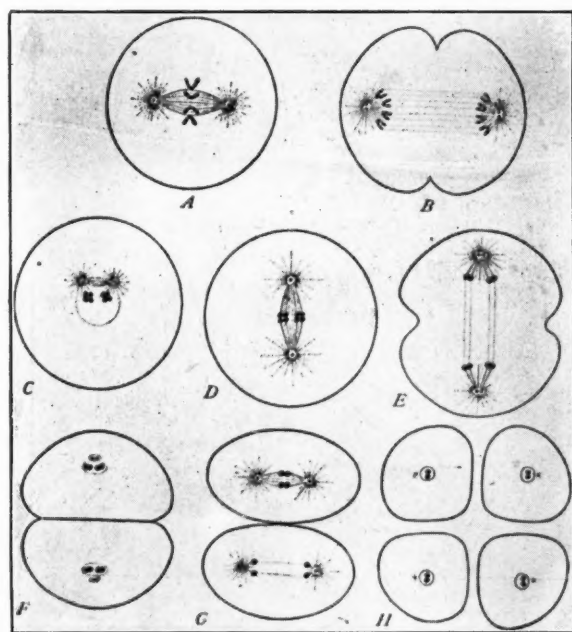


Fig. 9.—Diagram showing essential facts of gametogenesis in male. The somatic number of chromosomes is represented as four. A, a spermatogonial cell. B, mitosis of same. C, Primary spermatocyte preparing for division; chromatin forms two tetrads. D and F, division of C to form two secondary spermatocytes; this division also accomplishes segregation of the genetic factors of all allelomorphous pairs. G, H, division of the two secondary spermatocytes resulting in the reduced or germinal number of chromosomes. (After Wilson).

The process is essentially the same in oögenesis (Fig. 10) except that each primary oöcyte results in only a single functional egg. The other three potential eggs are eliminated as polar bodies in the two maturation divisions, sacrificed to the nutritional interest of the successful ovum.

Beside reduction of chromosomes these two maturation divisions accomplish another phenomenon, objective in our discussion. The primary gametocytes carry both genetic factors of an allelomorphous pair, one paternal, the other maternal in origin. The first division of gametogenesis (primary gametocyte) accomplishes allelomorphous segregation, i.e., separation of the genetic factors of any pair so that only a single factor passes into each of the secondary gametocytes. The subsequent simultaneous division of the two secondary gametocytes, in so far as the genetic factors are concerned is simply a distributional division. Thus half of the gametes in each sex carry the dominant and the other half the recessive genetic factor.

In fertilization the result depends directly upon which gametes fuse. Four possibilities in nature are evident as shown in scheme below (Fig. 11).  $D \times D$  give a homozygote ( $DD$ ),  $R \times R$  likewise a homozygote ( $RR$ ), while  $D \times R$  and  $R \times D$  give a heterozygote ( $DR$ ) which inbred in the  $F^2$  generation in sufficient number will throw the Mendelian ratio (1:2:1). Thus the law of Mendel is seen to rest upon the cytology of gametogenesis, the essential feature of which is the allelomorphic segregation resulting in a purity of gametes.

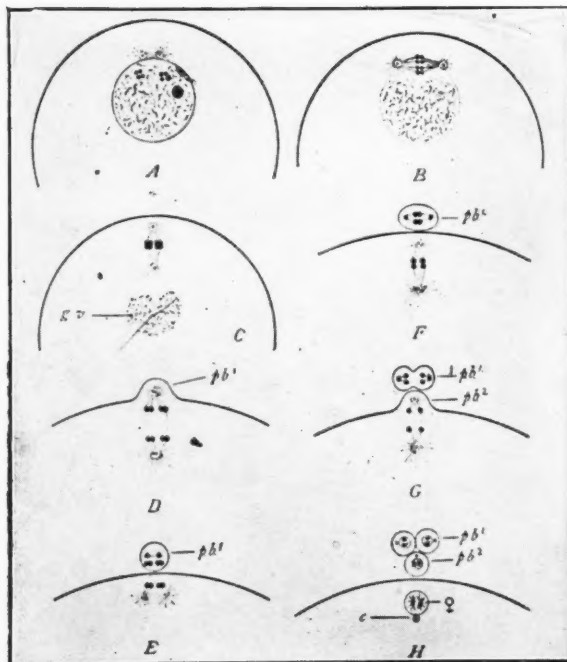


Fig. 10.—Diagram showing essential factor of oogenesis. The somatic number of chromosomes is represented as four. A, primary oocyte preparing for division, the chromatin has formed two tetrads. B, C, D, E, division of primary oocyte to form the two secondary oocytes, one of which is excluded as the first polar body. F, G, division of secondary oocyte and first polar body resulting in the expulsion from the egg of the second polar body. H, the single functional egg and three polar bodies with the reduced number (2) of chromosomes. (After Wilson).

The facts of gametogenesis and fertilization which are pertinent to our thesis may be summarized as follows: (1) At gametogenesis two phenomena are accomplished (a) Reduction of chromosomes from somatic number ( $2x$ ) to the germinal number ( $x$ ), (b) Segregation of paternal and maternal chromosomes hence of the genetic factors which they carry.

(2) Each gamete carries but one determinant of an allelomorphic pair, i.e., gametes are pure as regards genetic factors.

(3) Gametes carrying either the dominant or recessive factor are produced in equal numbers in each sex.

(4) Fertilization restores the somatic ( $2x$ ) number of chromosomes, one-half being paternal, the other half maternal in origin.

(5) The nature of the zygote swings with the character of the gametes fusing to produce it, resulting either in a homozygous dominant ( $DD$ ), a homozygous recessive ( $RR$ ) or a heterozygote ( $DR$ ).

(6) Heterozygotes inbred will, according to the law of combinations, throw the Mendelian ratio of 1:2:1.

The fundamental significance of gametic segregation in plant and animal breeding has, I trust, been made clear. We might suspect that in this respect man holds no unique position and accumulating evidence gratifyingly and completely substantiates our anticipations. If Mendelism means anything, it calls in no uncertain manner for application of its principles by those who are devoting their lives to social service, who desire not "promiscuously to swim down the turbid stream and make up the grand confusion," but rather to aid the soul of man on its lone way.

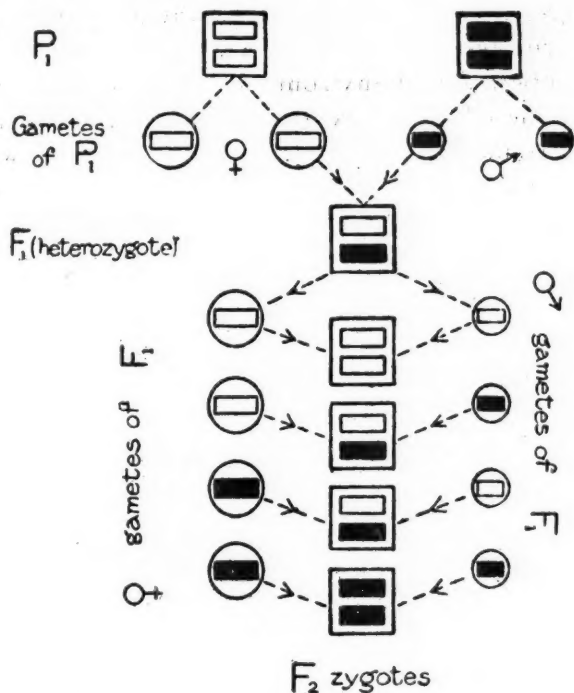


Fig. 11.—Diagram illustrating segregation of genetic factors at gametogenesis in the F<sub>1</sub> generation and their possible combinations in the F<sub>2</sub> zygotes according to the law of combinations. Mendel's Law rests upon this phenomenon of segregation of genetic factors at gametogenesis. (After Punnett).

Just as a farmer by tillage makes a better seed bed, so education, hygiene and sanitation, have made better the conditions under which we live. Unquestionably, education has bettered if not entirely made our environment what it is. By better culture the farmer may make the dwarf pea slightly less dwarf but to hope to ever educate a dwarf pea into a tall pea is absolutely futile. The social worker must face these facts. Do our present efforts in this direction hold out any promise of permanent advance? Are we not trying to elevate the race by endeavoring to lift and perpetuate the unfit. Mendelism answers that our present efforts are but mere palliatives; that our feelings are but temporizing with the facts; that we labor under a misconception of the nature of the organism. Eugenics offers the only avenue of permanent racial advancement. "Education is to man what manure is to the dwarf pea." The educated are in themselves the better for it. We are proud and rightly so of our institutions of learning, of reform, of detention and of moral uplift. Yet, the conspicuous efficiency with which these social agencies have functionated and should continue to function for human betterment should not bias our judgment.

The fact remains that all these forces will not alter one iota the irrevocable nature of the succeeding generation. The progeny of dwarf peas will forever be dwarf peas. Permanent progress is a matter of ancestry not of education, of eugenics not of eugenics; it is a consequence of gametic nature and not of environmental influence. We must ever hold to the front that individuals have their origin in a physiological process. The outcome of this process hinges absolutely upon the gametic constitution. The zygote is an aggregate of unit characters which in the ontogenesis of that individual are absolutely removed from any possibility of qualitative variation through the operation of environic forces. Conception irrevocably and unalterably casts the die. Education and environment can only serve to induce quantitative manifestations of qualities and powers fixed at gametic fusion. Mendelism marks the dawning of a new and a rational sociology.



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## EDITORIALS

### Making Appointments With School Children.

ANYONE who has ever attempted the practice of orthodontia realizes full well the difficulty that one encounters in getting school children to make appointments during school hours. This obstacle has been overcome in various ways. Some have followed the "path of least resistance" and have made appointments with their patients after school hours and on Saturdays, thus compelling practitioners to see such of their patients who attend school but once a week or late in the afternoon. Naturally the operator has had to "bunch" his appointments on Saturday; and on each of his other working days, the time during which he could see such patients has been limited to but a few hours each afternoon.

It is true that some practitioners will contend that they compel their patients to come when they want them, which is undoubtedly a good plan to follow. But let us look at this matter from another point of view. In a great many instances parents would not consider placing their children in the orthodontist's care during the school year if they thought that the treatment would interfere with the child's work in the schoolroom. We are often confronted with the question: "Will it interfere with the school work?" If we are interested in the business side of orthodontia, and we all

are, we are often forced to say that it will not, or else the case would not then be placed in our hands for treatment. After the parent has allowed the work to proceed with the understanding that the treatment will not interfere with the regular school session, it remains for us to make the appointments so that the child will not be absent from his classes at any time.

In order that the making of all appointments after school may be avoided, we must impress upon the parent that the correction of the malocclusion is more important to the child than a few hours spent in the schoolroom. We should make it a point to explain that the malocclusion is a detriment to the child's welfare and as such must be corrected early in life.

After we have put forth every argument conceivable to convince parents that orthodontic treatment is more essential to the child's future development than the necessary time he must take from his studies, we must not rest on our arms and think that we have won our point, for we still have the school authorities to consider.

It is hard for us to conceive how that any school official, supposed to possess more than the ordinary degree of knowledge, could for one instant question the great benefits to be derived from the noble work which we as orthodontists are fostering; but nevertheless it is an undeniable fact that great objections are encountered from this very source. The teacher objects, the principal disapproves, and the parent is "lukewarm." The child is confronted by the argument that if he misses school he will in all probability fail in his examinations. Naturally, many of our young patients would become discouraged and therefore refuse to make appointments during school hours.

In dealing with the pupils of private schools we experience our greatest difficulty; in many cases even after the regular school hours, it is impossible for us to see the pupils of such institutions. The reason given here is that "school rules" cannot be broken. The child can leave school but once a month and in some instances less often.

Some teachers might raise the question as to why we did not treat the child's teeth during the summer vacation period, but then, by way of argument, why not ask why they did not educate the child last winter?

This "rule of schools" which interferes with orthodontic treatment, exists because of an old custom, and because of the lack of knowledge as to what orthodontic treatment really means to the child's health and the long time required to treat the case; also because teachers are not familiar with the benefits to be derived from our work.

In a certain clinic last winter was begun the treatment of an extreme case of malocclusion, referred by the superintendent of one of the large public schools who realized full well the wonders that could be accomplished through orthodontic treatment. The boy's mouth was in bad shape. His adenoids had been removed, but he was still a mouth-breather. The superintendent was anxious to have the boy treated and watch results. After treating the case through the summer months, the boy's condition was greatly improved, and the improvement was noticed by the superintendent.

The next important feature of the case was when it was decided to adjust the retainers. The boy was informed that he must miss school. His reply was, "I will try." His appointment time came, but no boy. The

following Saturday when the boy was asked why he had not kept his appointment, his reply was: "The teacher would not allow me to leave school." The next appointment was arranged for the following week, but this time the matter was taken up directly with the superintendent. The result was that the boy was at the clinic at the required time. The superintendent informed the operator over the phone that it was more important from an educational standpoint that the boy keep his appointments at the clinic than be in school.

Therefore, it would appear that our great difficulty in the past in not being able to arrange appointments with school children during school hours has been due almost entirely to the fact that we have neglected to impress upon parents and teachers how really important from an educational standpoint it is to correct malocclusion of the teeth, regardless of the length of time that the student may be away from his classes.

Whenever we insist that our patients must call at a certain time we will in most cases find them willing to come, and by educating all concerned as to the importance of orthodontic treatment, we will not long meet the opposition with which we must now to a certain extent contend. —M. D.

### Classification of Malocclusion.

IN THIS issue of the Journal appears a communication entitled, "A Short Note On Classification," read by J. Sim. Wallace before the Sixth Annual Meeting of the European Orthodontia Society, held in London in 1913. This paper was written as a criticism of Angle's plan of classification. Knowing that a misunderstanding exists among certain members of the orthodontic profession as regards the diagnosis of malocclusion, the writer presented a paper, which is reported elsewhere in this issue, before the Central Association of Angle Graduates at its annual meeting in Chicago in November, 1914.

Much of the confusion that has arisen in the past in the classification of malocclusions, has been the result of a wrong conception as to the basis of classification. Some practitioners have taken the first molars as the basis; others the mesio-distal (antero-posterior) relation of the arches. Believing that it would tend to simplify matters by trying to get all orthodontists to accept the mesio-distal (antero-posterior) relation of the arches as the basis of classification, the writer showed a number of cases which would be confusing if classified from the mesio-distal (antero-posterior) relation of the molars; however, if the entire dental arch was taken as the basis, the conditions would be simplified, and treatment could be planned according to the classification. One of the things to be desired in "classification" is that it will describe the deformity in such a manner as to suggest treatment. Cases classified on the mesio-distal (antero-posterior) relation of the molars and the cases placed in Class I, II, and III, according to mesio-distal relation of the molars, would be very confusing, as the treatment would be decidedly different for cases in the same class.

If all cases which have a normal antero-posterior relation of the arches



are placed in one group—call it “Neutroclusion” or “Class I”—the treatment will consist of placing each tooth in its proper relation to the line of occlusion. Also, cases in which the lower arch is posterior or distal can be treated according to another plan and likewise those cases in which the lower arch is anterior or mesial.

If the classification is based on the mesio-distal relation of the molars, it will lead to a great amount of confusion, for there are a number of cases in which the upper molar will be mesial to the lower molar and the lower arch not posterior or distal to the upper arch. Likewise, there will be cases in which the lower molar will be mesial to the upper molar and the lower arch will not be mesial or anterior to the upper arch. A number of such cases were shown by the writer at Chicago in November.

Since that time letters have been received from several men, taking exception to the classification of Fig. 22 in “Practical Orthodontia” and shown in this issue of the Journal in the article on “Classification of Malocclusion” as Fig. 9. These letters came from men who have taken Angle’s course and they have insisted that the case should be called Class II, because the lower molar was distal to the upper, when in reality the upper molar is mesial to the lower. My reasons for calling the case in question a “Class I” case, are as follows: The lower arch is in normal antero-posterior relation to the upper arch as indicated by the deciduous teeth which have not been influenced by the extraction of other teeth, the upper molar has drifted forward (mesially or anteriorly) because of the extraction, and the lower molar is not distal to its proper relation with the upper arch.

The criticism of J. Sim. Wallace seems to be based on the supposition that Angle considered only the position of the molars in classifying malocclusion, which is not true as is shown by a paper read by B. Frank Gray before the meeting of the Alumni Society of the Angle School of Orthodontia and published in the *American Orthodontist*. Quoting from Gray’s paper, we find:

“Again if the lower second bicuspid or deciduous molar alone be missing, the first permanent molar may come forward until we have the condition represented in a Class III case; but the question is, should such a case be diagnosed as Class III? I think not, because the positions of the remaining teeth may bear no resemblance to that class of malocclusion. The etiological bearing of these cases is important, and a study along that line would reveal many causative factors which are peculiar to the different classifications. Therefore, while the mesio-distal relation of the six-year molars alone may be disturbed, I would be careful in my diagnosis; as the most of it is the result of an accident of development or of mutilation. The reverse of this condition would be brought about if the loss of the second bicuspid or deciduous molar be in the upper arch—producing, as it were, the mesio-distal relation of the Class II type. But all the factors which produce this class of irregularity may be absent; in fact may never have been present. Is it therefore more scientific to allow the accident which is responsible for the malrelation of the molars to influence our diagnosis, or shall we not take a broader view of the matter, and make our diagnosis after considering all of the features which affect the case? Ketcham, of Denver, advises me he diagnoses cases of the character I have mentioned as ‘Class I, Mutilated.’



In those cases where extraction has been resorted to, this designation is certainly good; but where the condition is due to an accident of development the case might better be termed 'Class I, Modified.' "

Angle in discussing the paper and in referring to a case, says:

"Very naturally mutilations often complicate diagnosis and the case in question is a pronounced example of such cases. There are two ways of looking at the matter. First, to make the diagnosis from the present appearance of the teeth or from the symptoms only; and second, from the basis of normal occlusion—the only true way to make a diagnosis of malocclusion.

"If we judge from the symptoms or the relations into which we find the teeth to have drifted, as a result of mutilations, we must classify this case as Class II, Division 1, but if we study it carefully we will see that as a result of the loss of the second upper deciduous molars, the first upper permanent molars have been forced to take a position mesial to that which nature intended them to occupy. They have therefore locked mesially with the lower molars, and this, with the protrusion of the upper incisors, gives the case the appearance of belonging to the first division of Class II. In reality, however, keeping clearly in mind the position—it will be seen that the case does not belong to that class at all, but to Class I, for without the mutilations the molars would lock normally, and when the upper first molars are placed in their normal positions the teeth will again lock normally.

"So I would say, judge not from appearances—the position of the teeth that have migrated, but from the normal positions of the upper first molar. And where any mutilation has occurred and is followed, as it inevitably is, by the shifting of position of remaining teeth, then study to resolve the occlusion into its original conditions and correct diagnosis will not be difficult."

Much confusion has also resulted from men using the terms "mesio-distal relation of the molars" and "mesio-distal relation of the arches" as if they were synonymous, which is not true. If all would use the same terms and the same basis of classification how much better it would be for the science.

—M. D.

## ORTHODONTIC NEWS AND NOTES

*This Department is in charge of Dr. H. C. Pollock, 808-809 Metropolitan Building, St. Louis.  
To avoid delay, communications in regard to notes should be sent direct.*

*The Future Role of Orthodontia.*—With preventive measures, healthy environment, earlier treatment, and higher ideal, even comparatively slight mal-alignments of individual teeth will be corrected. Such defects will not be neglected as being merely of esthetic importance. I look to the time when the Greek ideal of physical perfection may be recovered, and when a stigma will rest upon any parent who allows his child to grow up with any remedial deformity perpetuated. In certain classes of the community, this condition obtains today. All that is necessary is wider and more general knowledge and appreciation. Prevention will reduce the amount of curative work to be done, and we hope that what has to be done will come so much more and more under the fostering care of the State that nearly every child may reach maturity so perfectly equipped in health, physique, and the beauty that comes of these, as to make him one of a finer race of citizens than the world has yet seen, able to acquit themselves like men, and do for the next generation what has been done for them.—*N. G. Bennett, Ash's Canadian Monthly Circular. (From Dental Cosmos.)*

The third annual meeting of the *Pacific Coast Society of Orthodontists* was held at the Cliff Hotel, San Francisco, February 22, 23 and 24. Dr. Wm. H. Bolton of Seattle presided, while the following program was presented:

On Monday, February 22, at 2:00 P.M., the meeting was called to order and the business session was held. At 3:00 P.M. the president, Dr. W. H. Bolton, Seattle, Wash., delivered the president's address on "Oral Prophylaxis," and the Discussion was opened by Dr. John R. McCoy.

On Tuesday, February 23, the following papers were presented: 10:00 A.M., "Review of Orthodontic Literature for 1914" by Dr. John R. McCoy, Los Angeles; 11:00 A.M., "Restoration of the Lost Parts of the Dental Apparatus" by Dr. Fred. Hart, San Francisco; 2:00 P.M., "Constitutional Disorders as an Etiological Factor of Malocclusion in Children" by Dr. James D. McCoy, Los Angeles, Discussion opened by Dr. W. H. Bolton; 3:00 P.M., "Disintegration of Tooth Structure" by Dr. A. A. Solly, San Francisco, Discussion opened by Dr. C. O. Engstrom, Sacramento.

On Wednesday, February 24, the following were presented: 10:00 A.M., "Focal Infection" by Dr. J. J. Hogan, San Francisco, Discussion opened by Dr. James D. McCoy; 11:00 A.M., "Orthodontia Difficulties" by Dr. W. D. Morse, Los Angeles, Dis-

cussion opened by Dr. R. A. Day; 2:00 P.M., Clinics as follows: "Demonstrating Soldering Technique" by Dr. Herbert Samuels; "Some Essential Points in X-Ray Technique" by Dr. James D. McCoy; "New Prophylactic Tooth Brush" by Dr. C. O. Engstrom; "Method of Adjusting Lingual Wires" also "Exhibit of Tumor Case" by Dr. A. A. Solly; "Demonstrating the Strong Archeograph and the Ketcham Arch Annealer" by Dr. Robert Dunn; "The By-Effects of Ligatures" by Dr. John R. McCoy; "Demonstrating Expansion of the Superior Deciduous Arch" by Dr. W. D. Morse.

The election of officers for the ensuing year resulted in Dr. James D. McCoy of Los Angeles being named President, while Dr. John R. McCoy of Los Angeles was re-elected Secretary-Treasurer. It was decided to hold the next meeting in San Francisco during February, 1916.

\* \* \* \*

*The Dewey School of Orthodontia Alumnae Association* held its Winter Meeting at Hotel Baltimore, Kansas City, Mo., February 23rd to 27th. The program follows:

B. E. Lischer, St. Louis, Mo.—

"Nomenclature of Malocclusion."

Vilray P. Blair, St. Louis, Mo.—

"Oral Surgery and Its Relation to Orthodontia."

H. C. Pollock, St. Louis, Mo.—

"Orthodontia and Its Relation to the Public."

Joseph E. Johnson, Louisville Ky.—

"Malocclusion in Young Children."

Friedrich Hecker, Kansas City, Mo.—

"Rickets as a Causative Factor in Malocclusion."

M. N. Federspiel, Milwaukee, Wis.—

"Oral Surgery." (Four lectures.)

W. A. Coston, Topeka, Kansas—

"Orthodontia in General Practice."

T. G. Duckworth, San Antonio, Texas—

"X-Ray Photography."

W. A. McCarter, Topeka, Kansas—

"Orthodontia in Small Communities."

S. J. Renz, Kansas City, Mo.—

"The Preventative Treatment of Malocclusions."

Martin Dewey, Kansas City, Mo.—

(1) "The Loop Appliance;" (2) "The Development of the Maxillae."

On Friday night, February 27th, the annual banquet was held at Hotel Baltimore. The meeting, on account of the unusually large attendance, proved highly interesting and profitable to orthodontists.

